VarSet™ Low Voltage Capacitor Banks

User Manual

EAV8833200
07/2014

Schneider Electric

Safety information

Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please note

Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

Chapter 1 Safety precautions 5
Chapter 2 Introduction 7
Installation overview 7
Document replacement 8
Chapter 3 Receiving, handling, and storing 9
Receiving 9
Handling 9
Handling with lifting straps 10
Handling with a forklift 11
Storing 12
Chapter 4 Equipment description 13
VLVAW2N and VLVAW3N systems 13
VLVAF4P and VLVFF4P system 14
Catalog numbering system 15
Chapter 5 Installation 17
Foundation preparation 18
Capacitor bank preparation 18
Installation 18
Wall-mounted enclosures installation 19
Wall-mounting dimensions 20
Detail of the mounting brackets 20
Floor-standing enclosures installation 21
Floor-standing dimensions 22
Assembly of plinth (when purchased as an accessory) 23
Grounding 25
Cable pulling 26
Cable terminations 29
Current transformer (CT) 30
CT shorting bar 30
Current transformer position 31
Alarm connection 32
Sizing the overcurrent protection device 32
Connection of the communication accessory 32
Chapter 6 Startup and commissioning 33
Instruments required for commissioning 33
Pre-energizing procedure 33
Startup procedure 37
Power factor controller 39
Power factor controller programming 39
Manual setup of the NR12 controller 40
NRC12 controller programming 43
Inspect and activate the capacitor bank 47
Troubleshooting 49
STEP.TST 50
Complete the activation 50
Chapter 7 Preventive maintenance (PM) 53

First scheduled PM (three months after commissioning) 53
Regularly scheduled PM (every 6-12 months) 55
Replacement of components 58

Chapter 8 Torque values for connections 61
Chapter 9 Lug and wire size information 63
Chapter 10 Maintenance records 65
Equipment information 65
Installation and maintenance log 65
Main bus insulation resistance record 66
Contactor insulation record 66
Voltage and stage current record 67

Chapter 11 Dimension and weight information 69
Chapter 12 Change the language in the controller 71

Chapter 1 Safety precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.

⚠ DANGER

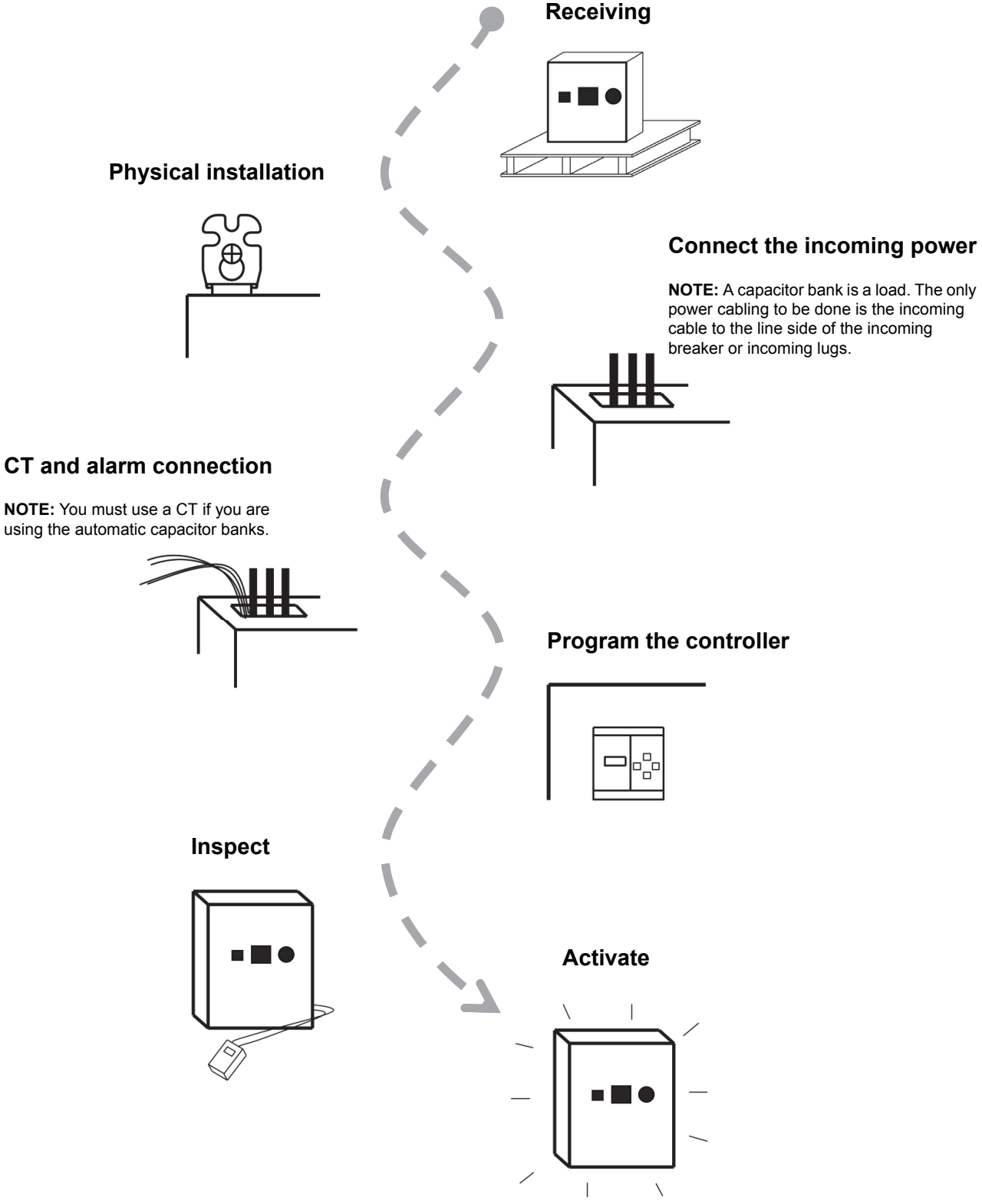
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

Chapter 2 Introduction

Installation overview


Receiving
Physical installation
Connect the incoming power
NOTE: A capacitor bank is a load. The only power cabling to be done is the incoming cable to the line side of the incoming breaker or incoming lugs.
CT and alarm connection
NOTE: You must use a CT if you are using the automatic capacitor banks.
Program the controller
Inspect
Activate

This manual contains instructions for the proper installation, operation, and maintenance of VarSet™ low voltage capacitor bank equipment manufactured by Schneider Electric. The purchaser's engineering, installation, and operating staff should familiarize themselves with this manual and become acquainted with the appearance and characteristics of each piece of equipment mounted or contained in the capacitor bank. This user manual covers the following enclosures:

- VLVAW2N
- VLVAW3N
- VLVAF4P
- VLVFF4P

These instructions and procedures apply to VarSet low voltage capacitor bank installation. When special features or non-standard components are incorporated in the capacitor bank, detailed instructions for these components are included in the instruction material holder.

Document replacement

Contact your nearest Schneider Electric field office to replace lost or damaged wiring diagrams and instruction sheets. Use the factory order number found on the nameplate for reference.

Chapter 3 Receiving, handling, and storing

Receiving

Upon receipt, check the packing list against the equipment received to ensure the order and shipment are complete. Also upon receipt, immediately inspect capacitor bank sections for any damage that may have occurred in transit. If damage is found or suspected, file a claim with the carrier immediately and notify the nearest Schneider Electric representative.

Check for the documents included:

- VarSet user manual
- Varlogic user manual (NR12 or NRC12)
- Control wiring diagram
- Power wiring diagram
- Incoming circuit breaker instruction bulletin (incoming circuit breaker units only)
- Devices drawing
- Modbus connection unit user manual (units with communication only)

Handling

NOTICE
HAZARD OF EQUIPMENT DAMAGE Do not lay the equipment on its back, front, or sides. **Failure to follow these instructions can result in equipment damage.**

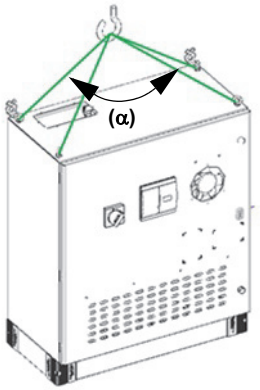
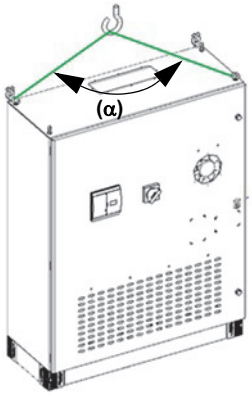
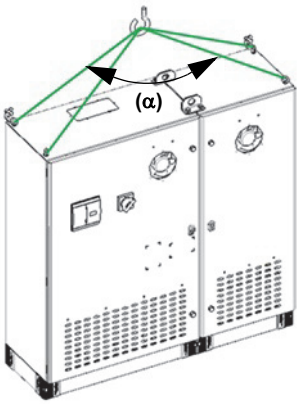
Ensure that proper equipment such as an overhead crane is available at the installation site to handle the capacitor bank. This equipment will help avoid injury to personnel and damage to the capacitor bank.

Verify the lifting capacity of the equipment being used to handle the capacitor bank in accordance with the shipping weight of each shipping section. Keep the capacitor bank upright during handling.

Schneider Electric recommends using an overhead crane, lifting straps, and cables or chains to handle the capacitor bank. This method and alternative handling methods are discussed in this section.

Handling with lifting straps

Remove the equipment from its transport pallet using lifting straps as shown in the following table.

Type	**VLVAW2N and VLVAW3N enclosures**		**VLVAF4P and VLVFF4P enclosures**
Angle	**Option 1**	**Option 2** [1] [2]	**Required** [2]
Maximum (α) 60°			
Maximum weight of enclosure (for reference only, subject to change without notice)	175 lb (80 kg)	330 lb (150 kg)	585 lb (265 kg)

[1] Take necessary precautions while lifting to avoid tilting the equipment.

[2] In case slings are used, it is advisable to use all the hoisting rings on the equipment.

NOTE: You must remove the eyebolts after equipment is in its final place and mounted.

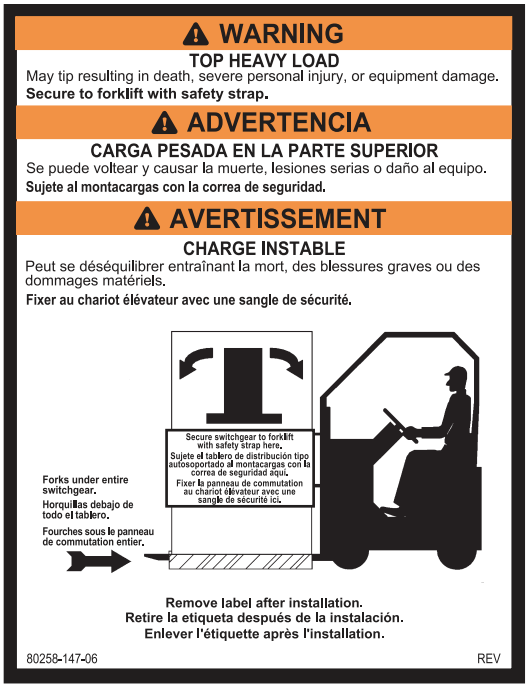
After moving the equipment, do the following:

1. Unscrew the eyebolts and collect the brackets from inside the enclosure.
2. Install plastic plugs contained within the gland plate bag.

Handling with a forklift

A forklift is an alternative method of handling the capacitor bank.

NOTE: Always check the fork lengths to ensure that the forks extend under the entire capacitor bank. Carefully balance the load and always use a safety strap when handling or moving a capacitor bank with a forklift.


WARNING
TOP HEAVY LOAD
May tip resulting in death, severe personal injury, or equipment damage.
Secure to forklift with safety strap.
ADVERTENCIA
CARGA PESADA EN LA PARTE SUPERIOR
Se puede voltear y causar la muerte, lesiones serias o daño al equipo.
Sujete al montacargas con la correa de seguridad.
AVERTISSEMENT
CHARGE INSTABLE
Peut se déséquilibrer entraînant la mort, des blessures graves ou des dommages matériels.
Fixer au chariot élévateur avec une sangle de sécurité.
Secure switchgear to forklift with safety strap here.
Sujete el tablero de distribución tipo autosoportado al montacargas con la correa de seguridad aquí.
Fixer le panneau de commutation au chariot élévateur avec une sangle de sécurité ici.
Forks under entire switchgear.
Horquillas debajo de todo el tablero.
Fourches sous le panneau de commutation entier.
Remove label after installation.
Retire la etiqueta después de la instalación.
Enlever l'étiquette après l'installation.
80258-147-06
REV

NOTE: You must remove the eyebolts after equipment is in its final place and mounted.

After moving the equipment, do the following:

1. Unscrew the eyebolts and collect the brackets from inside the enclosure.
2. Install the plastic plugs contained within the gland plate bag.

Storing

When storing the capacitor bank before installation, cover the top and openings of the equipment to protect the capacitor bank from dust and debris.

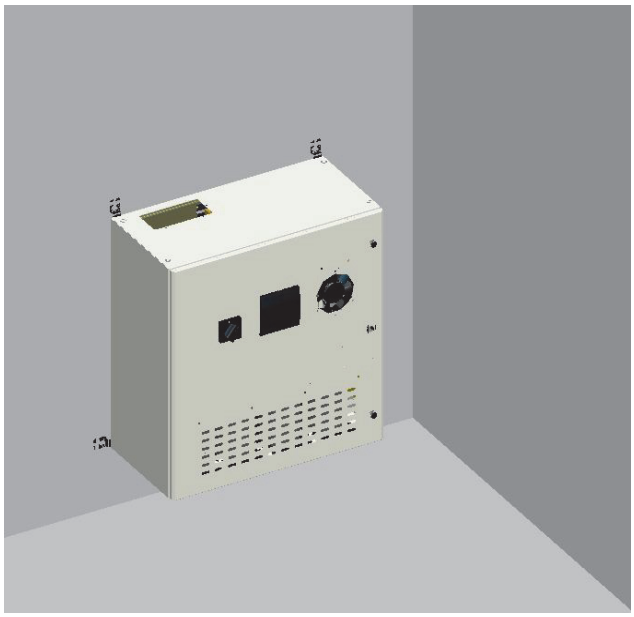
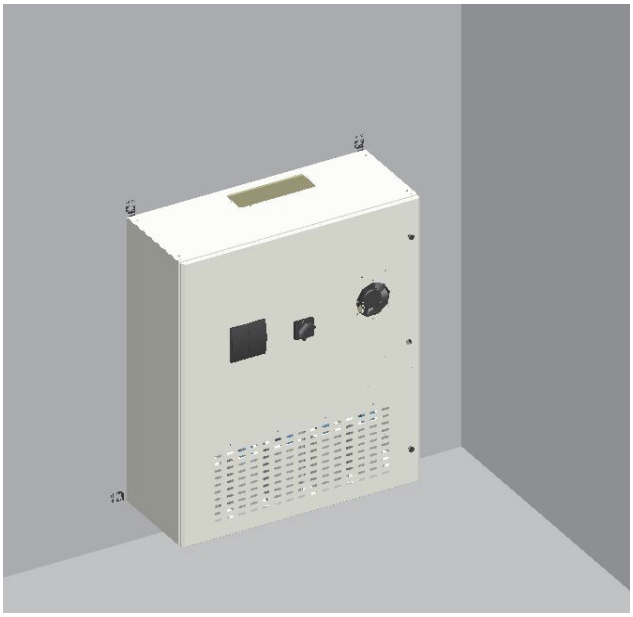
Do not store in an outdoor location even if covered by a tarp. If a capacitor unit is not installed and energized immediately, store it in a climate controlled building with adequate air circulation and protect it from dirt, airborne contaminants, and water. The acceptable storage temperatures are from -10°C (14°F) to 40°C (104°F).

Chapter 4 Equipment description

VLVAW2N and VLVAW3N systems

The VLVAW2N and VLVAW3N systems consist of capacitors controlled by contactors and a power factor controller to control the operation of the contactors. The power factor controller continually monitors the load power factor and automatically adjusts the number of capacitors connected to the line to regulate the reactive power compensation level to meet the power factor target. These non-detuned banks are for networks with low harmonic producing loads.

Two enclosure sizes are available depending on the power required. The systems are available with an incoming breaker as an option (suffix AB) or with a main terminal block (suffix AA).

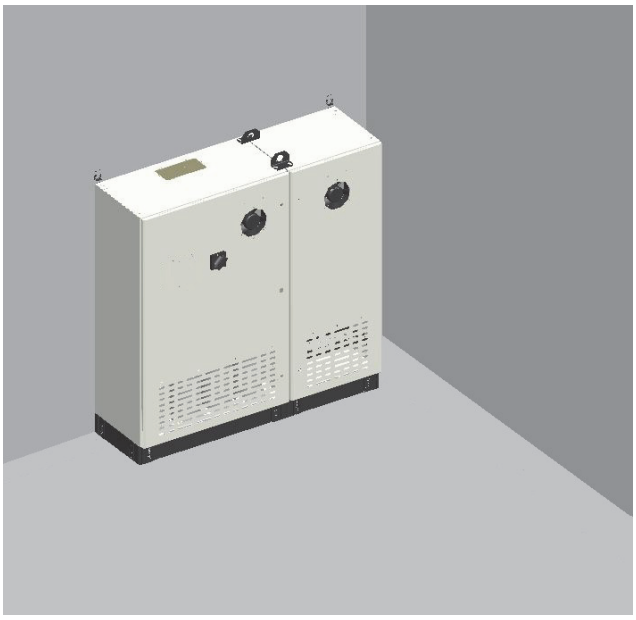
VLVAW2N	VLVAW3N
	

VLVAF4P and VLVFF4P system

The VLVAF4P is a detuned capacitor bank that consists of capacitors and reactors controlled by contactors and a power factor controller to control the operation of the contactors. The power factor controller continually monitors the load power factor and automatically adjusts the number of capacitor/reactor stages connected to the line to regulate the power factor. The detuned reactors contained in this bank are three phase inductors dedicated to attenuating the amplification of harmonics on highly polluted networks while protecting the different components of the installation.

The VLVAF4P system is available with an incoming breaker as an option (suffix AB) or a main terminal block (suffix AA).

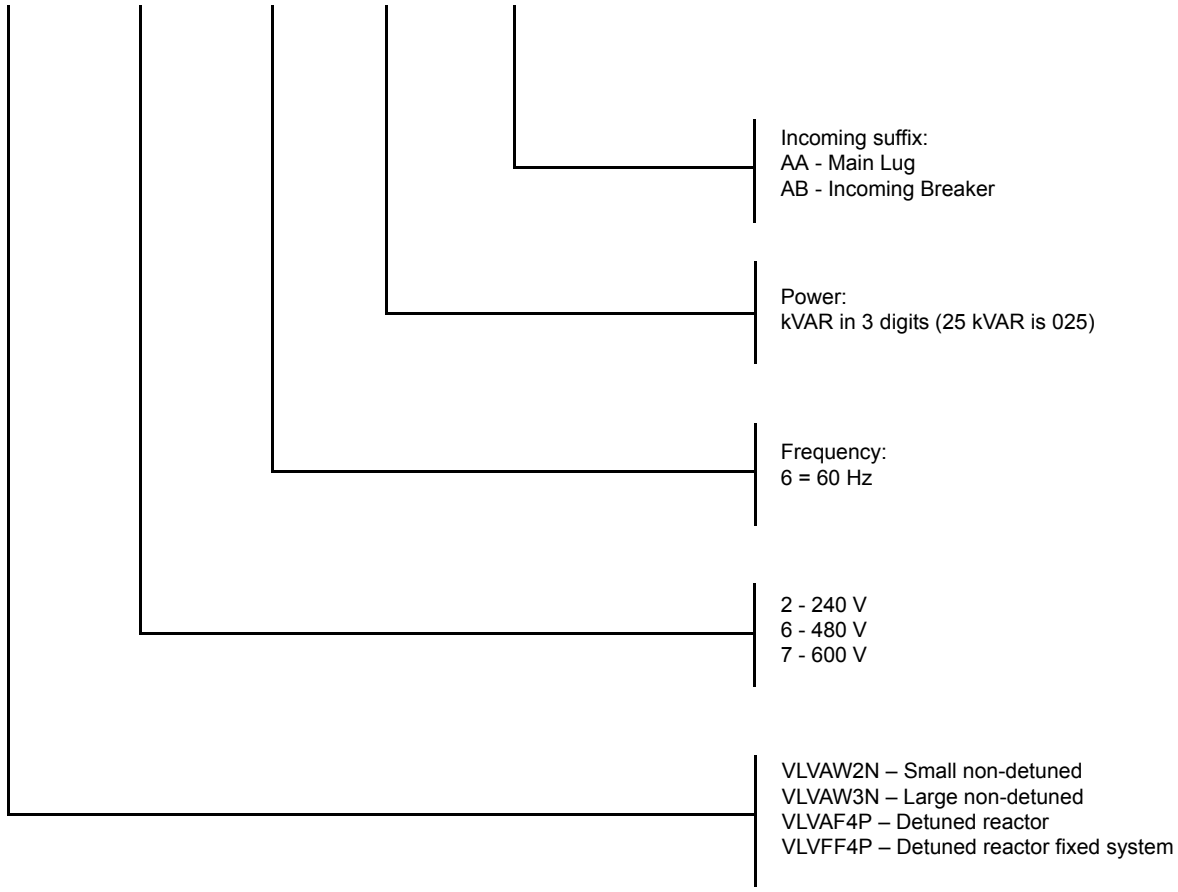
The VLVFF4P is available as a variant of this system. It is a fixed capacitor bank with no power factor controller. The bank will operate continuously at full load regardless of network need.

VLVAF4P	VLVFF4P
	

Catalog numbering system

The following catalog numbering system provides the basic equipment information. Consult Schneider Electric for other number definitions.

VLVAW2N + 1 digit + 1 digit + 3 digits + 2 letters



Chapter 5 Installation

Correct installation of VarSet low voltage capacitor banks is essential for proper operation of all capacitor bank components. Study the associated instruction books and all drawings carefully.

NOTE: Do not stand on any part of the capacitor bank.

The location chosen for installation should provide working clearances complying with the appropriate section of the National Electrical Code® (NEC®) or the Canadian Electrical Code (CEC).

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

NOTE: If the bank is to be installed on a network with a backup generator, ensure that the harmonics generated by the generator do not exceed the recommendations for the capacitor banks. If they do exceed recommendations, ensure that the capacitor bank is on a separate circuit that will not be activated when the generator is running.

Capacitor banks require field connections including mains and ground to be accessible and maintainable from the front and should allow adequate space for the door from the equipment front. (See dimension D1, the maximum distance the door swings open, in “Section dimension and weight” on page 69.)

Capacitor banks are not designed to be placed in hazardous locations. The area chosen should be well ventilated, free from excess humidity, dust, and dirt. The unit can be used up to a maximum elevation of 2000 meters (6562 feet). The temperature of the area at any given moment should be no lower than -10°C (14°F) and no higher than 40°C (104°F). However, the amount of time in continuous operation should be limited to the following:

- 24 hour average: +40°C (104°F)
- 1 year average: +30°C (86°F)

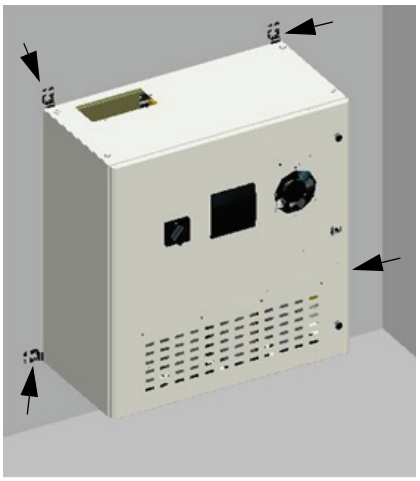
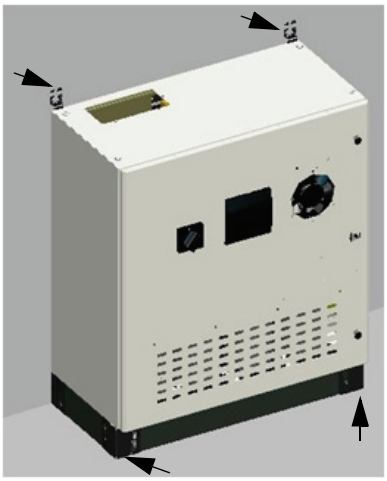
Foundation preparation

The floor or foundation must be strong enough to support the weight of the capacitor bank without sagging. Weight specifications are provided in “Section dimension and weight” on page 69. The surrounding floor area should gently slope toward a drain.

Capacitor bank preparation

Remove dirt and debris from the foundation and surrounding area before moving the capacitor bank into the final position. Remove all packing and shipping materials.

Installation

Wall mounting	Floor Mounting (against wall)	Floor Mounting
		
With or without Plinth. Four points of fixation on the wall.	Two points of fixation on the wall. Two points on the floor for all models except VLVAF4P and VLVFF4P.	Four points of fixation on the floor. Valid for VLVAW2N and VLVAW3N models only.

Wall-mounted enclosures installation

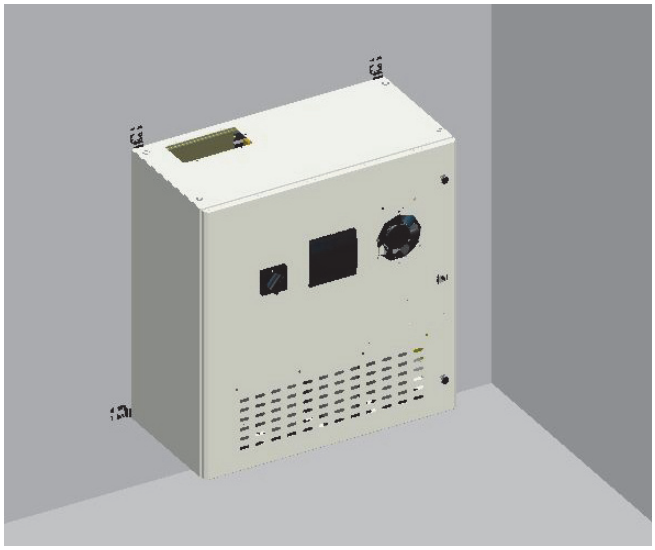
⚠ WARNING

RISK OF THE ENCLOSURE FALLING

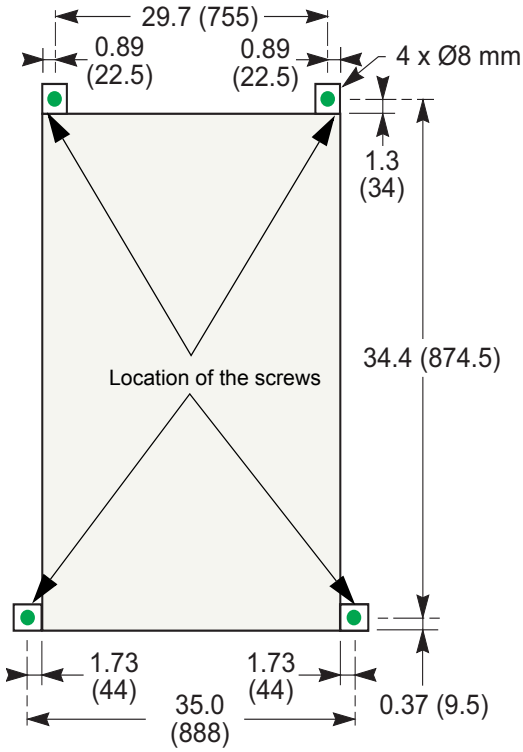
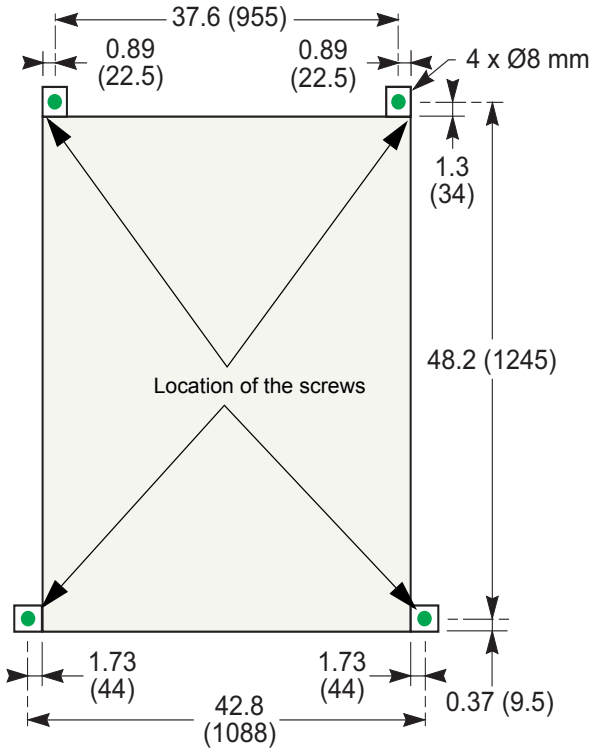
- Mount the equipment using the attachment points indicated below.
- Use fasteners adapted to the type of support and the weight of the equipment. Approximate weights are listed in “Section dimension and weight” on page 69.
- Ensure that the wall is adapted to support the necessary weight.
- Only use the mounting supports shipped with equipment.

Failure to follow these instructions can result in death, serious injury or equipment damage.

VLVAW2N and VLVAW3N enclosures

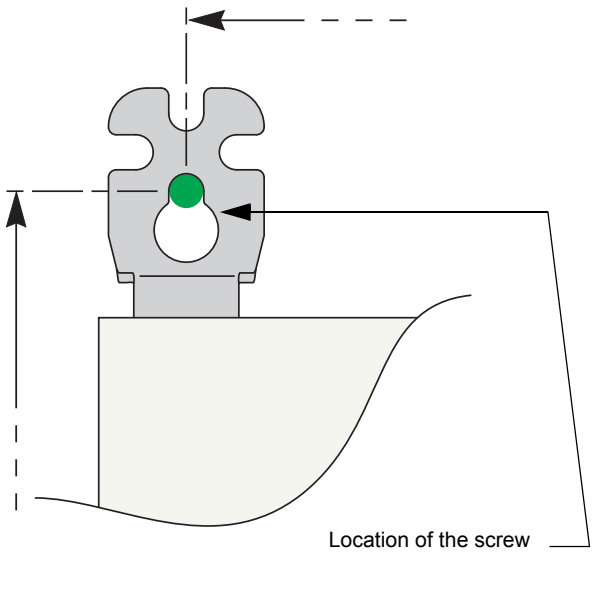
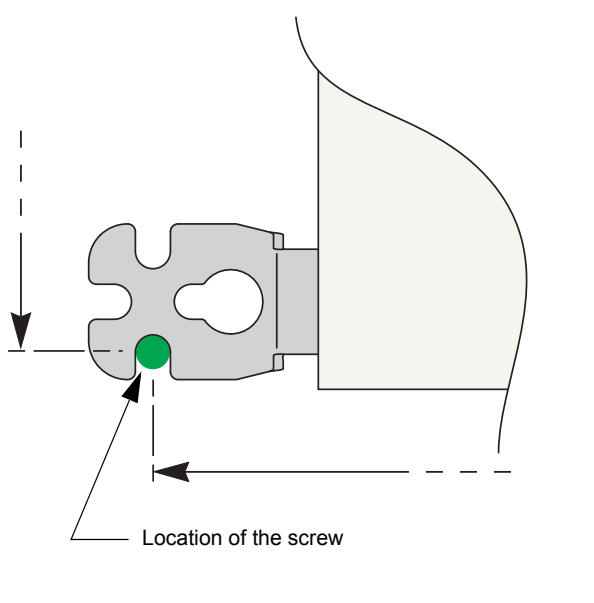


Wall-mounting dimensions

VLVAW2N	VLVAW3N
	

inches (mm)

Detail of the mounting brackets

Top of the enclosure	Bottom of the enclosure
	

Floor-standing enclosures installation

Floor-standing installation is for any VarSet bank equipped with a floor-standing plinth.

⚠ WARNING

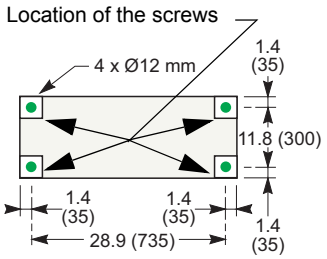
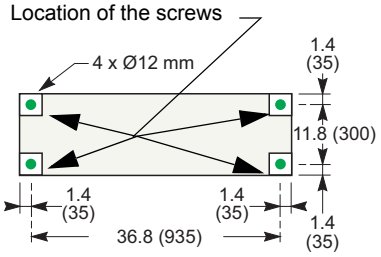
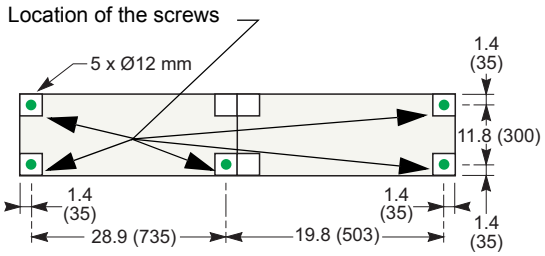
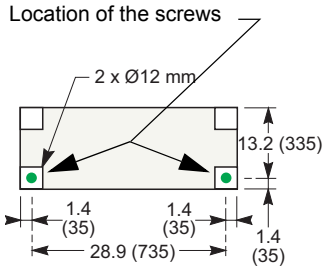
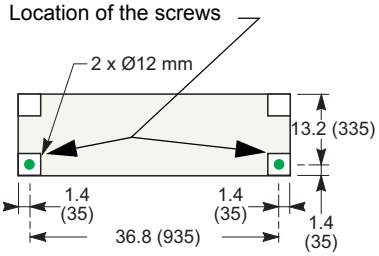
RISK OF THE ENCLOSURE TILTING

- Mount the equipment using the attachment points indicated below.
- Use fasteners adapted to the type of support and the weight of the equipment. Approximate weights are listed in “Section dimension and weight” on page 69.
- If mounting and attaching against a wall, ensure that the wall is adapted to support the necessary weight

Failure to follow these instructions can result in death, serious injury or equipment damage.

VLVAW2N enclosures	VLVAW3N enclosure	VLVAF4P and VLVFF4P enclosures

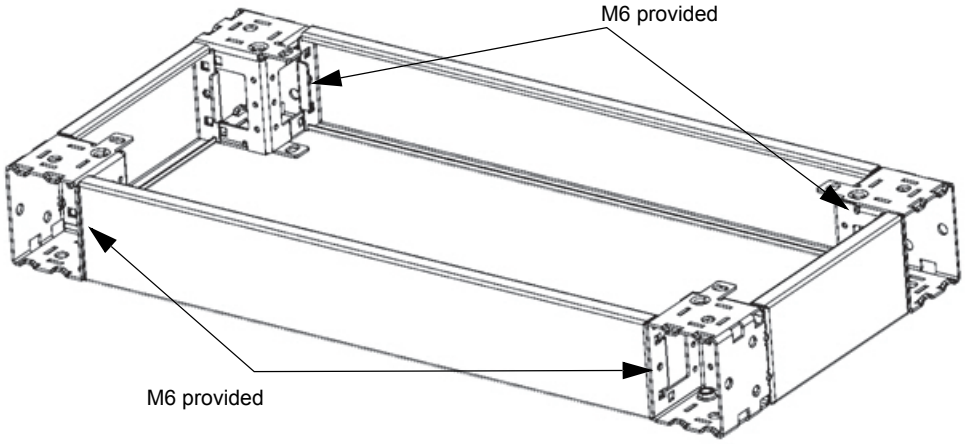
Floor-standing dimensions

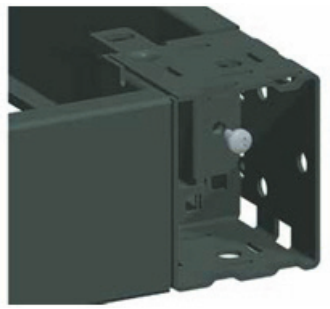
<table>
<tr><th>VLVAW2N</th><th>VLVAW3N</th><th>VLVAF4P and VLVFF4P</th></tr>
<tr><td> 
</td><td> 
</td><td rowspan="3"> 
</td></tr>
<tr><th>VLVAW2N
(installation against a wall)</th><th>VLVAW3N
(installation against a wall)</th></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="3">inches (mm)</td></tr>
</table>

NOTE: For installation against a wall you must also use two wall-fixing brackets as described in “Wall-mounted enclosures installation” on page 19.

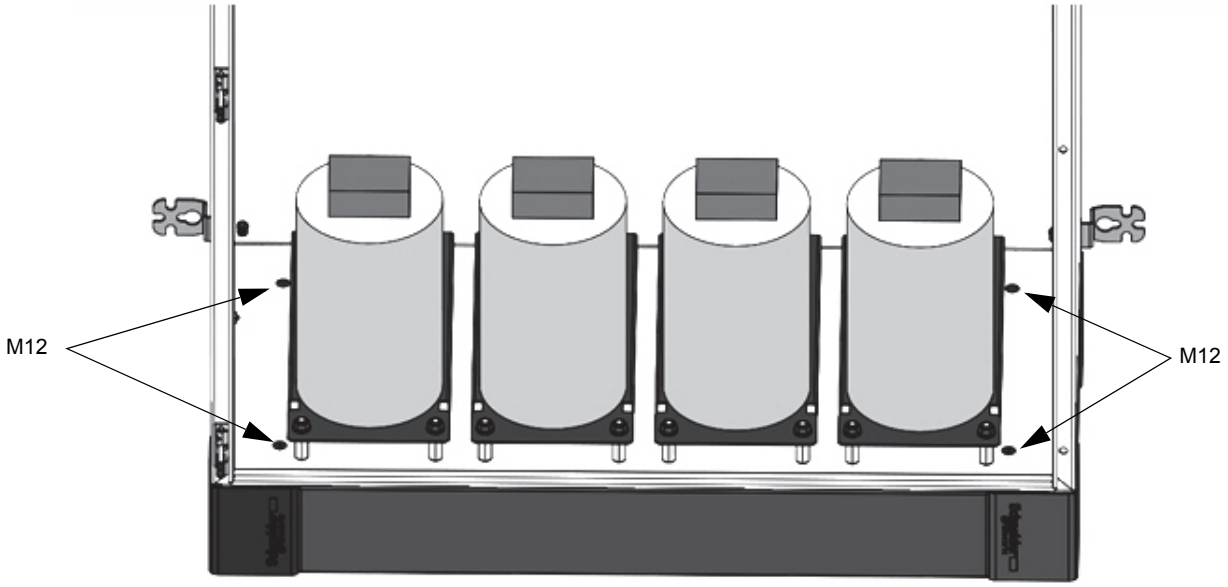
Assembly of plinth (when purchased as an accessory)

Assembly

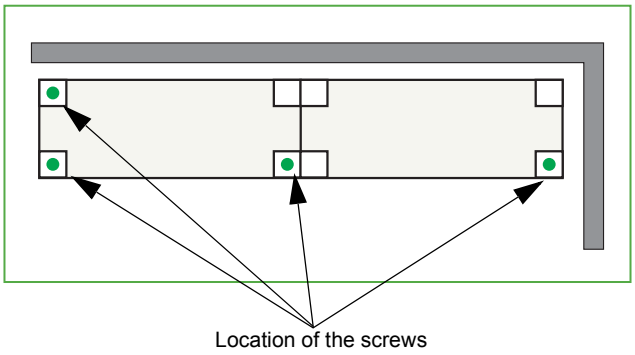




Attachment to the enclosure

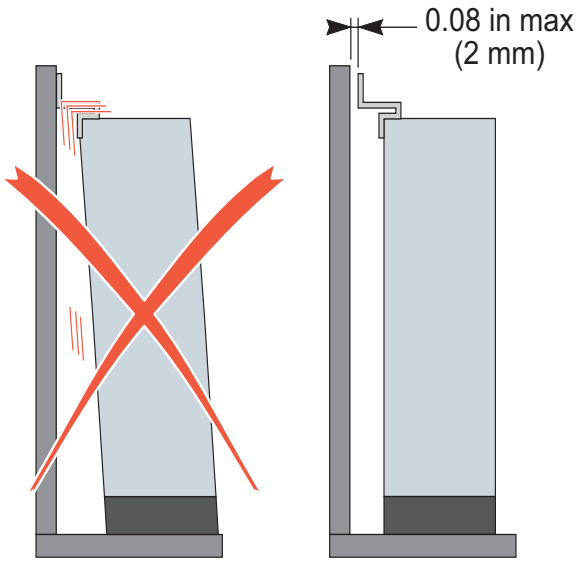


Corner mounting two modules



NOTE: Do not install modules in a “U-shaped” space. At least one side must have open space.

Maximum allowed gap between wall and top mounting brackets before fastening



To attach the equipment to the floor:

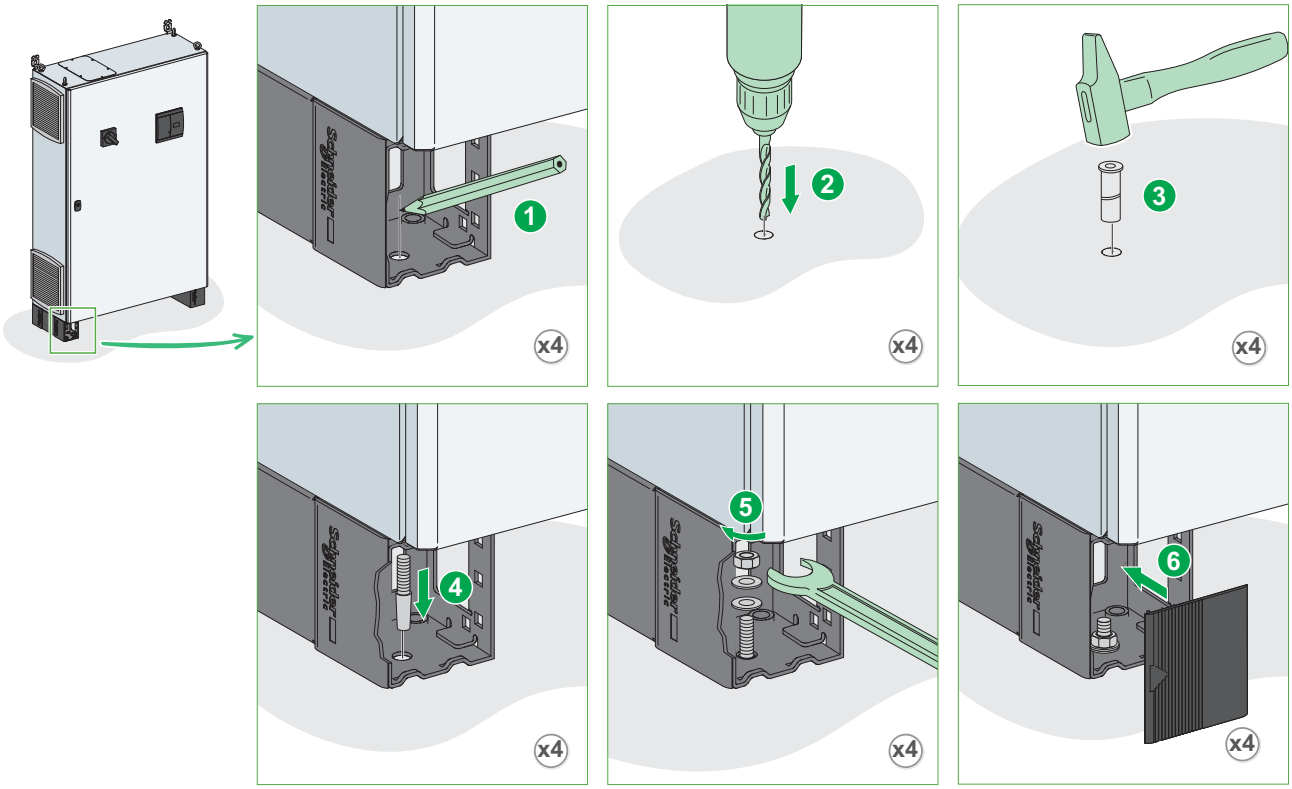
1. Position the equipment at the chosen location.
2. Unclip the covers from the corners of the base.
3. Mark the fixing points; see dimensions above.
4. Remove the equipment.
5. Drill holes into the floor (diameter of the mounting hole: 15 mm [0.59 in]) and position the mounting brackets (diameter: 12 mm [0.47 in]).
6. Position the equipment in its location, install and tighten the mounting screws.

⚠ WARNING

RISK OF THE ENCLOSURE TILTING

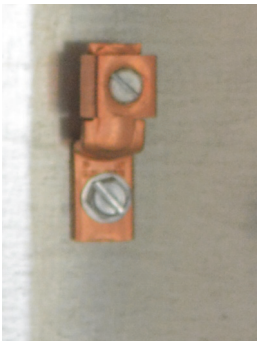
- Mount the equipment using the attachment points indicated below.
- Use fasteners adapted to the type of support and the weight of the equipment.
- Only use the floor plinth/pedestal that comes with the equipment or that is ordered as an accessory from the VarSet catalog.

Failure to follow these instructions can result in death, serious injury or equipment damage.



Grounding

Run a grounding conductor from the grounding electrode at the installation site to the grounding connector (ground lug) located near the incoming gland plate and attached to the mounting plate. Select the material and size of this grounding conductor to comply with the NEC or CEC and install it as specified. Refer to “Incoming wiring” on page 63 for grounding lug sizes.



Cable pulling

VarSet low voltage capacitor banks are provided with a gland plate for top-feed connection only. Capacitor bank section components are arranged to give proper cable clearance and bending space for cables entering the capacitor bank section as specified on the equipment drawing.

Observe these guidelines when pulling cables:

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

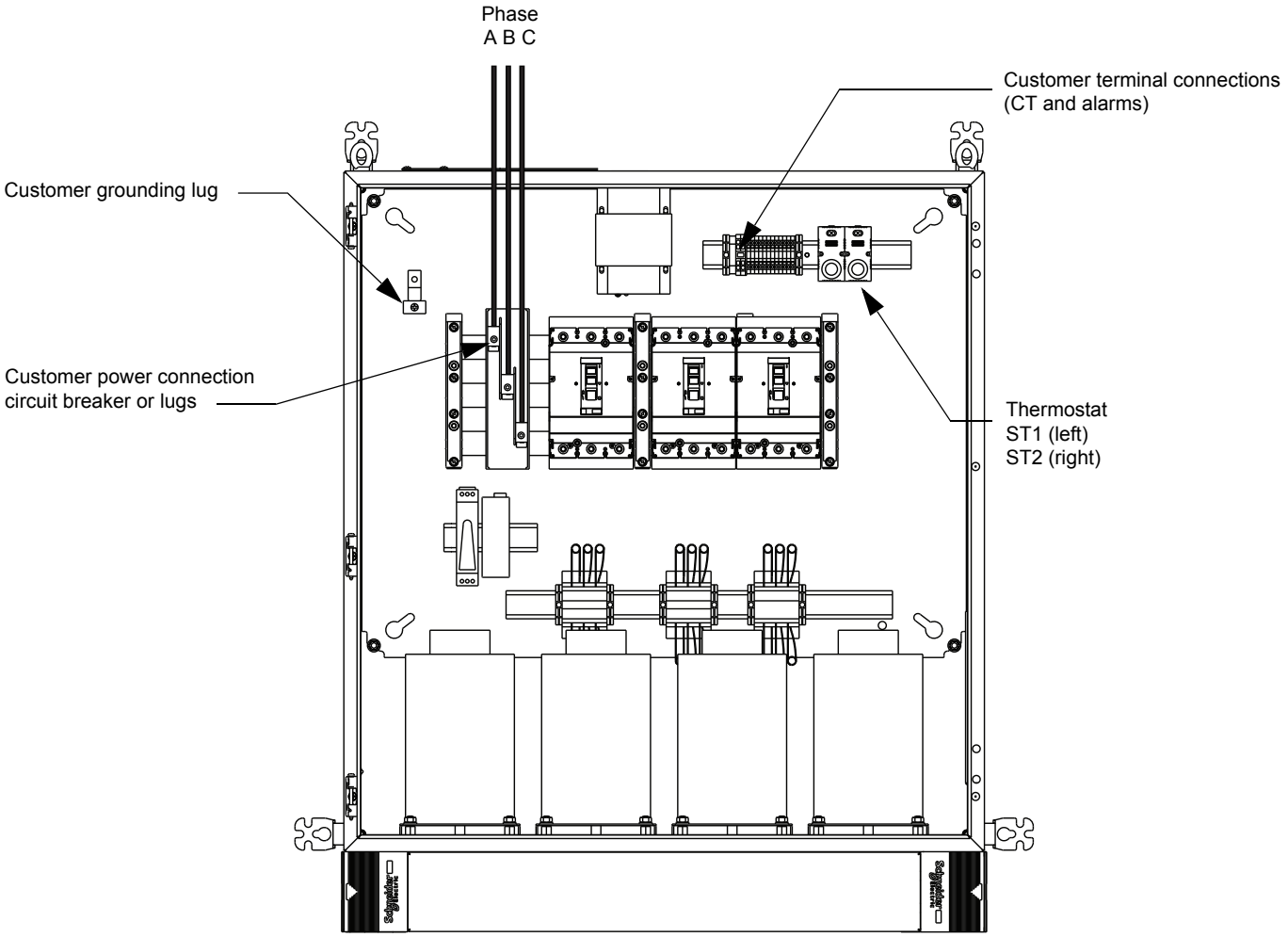
Ensure that the equipment is attached to the wall and/or floor before beginning the power cabling procedure.

Failure to follow these instructions will result in death or serious injury.

- Use only cable sizes suitable for a proper fit with the corresponding terminal blocks. Refer to “Lug and wire size information” on page 63 for lug accepted wire sizes.
- Pull the proper size and number of cables according to appropriate local standards and NEC or CEC.

  NOTE: Wire size must be at least 135% of the nominal current rating.
- Position the cables inside the capacitor bank section so that they are not subject to physical damage.
- Maintain the maximum possible bending radii and proper clearance to bus bars and grounded parts. If any cables are laying or bearing on structural members, support them to relieve this condition or place suitable protective material at the bearing point to protect the cable insulation.
- Be certain to run all phase conductors through the same opening where cables enter or leave the capacitor bank section or pass through any metal that has magnetic properties. Otherwise, overheating can result.

The items in this illustration below require wiring/adjustment during the installation described in the following pages. Exact location/size of components may vary between models.



NOTE: A capacitor bank is a load. The only power cabling to be done is the incoming cable to the line side of the incoming breaker or incoming lugs.

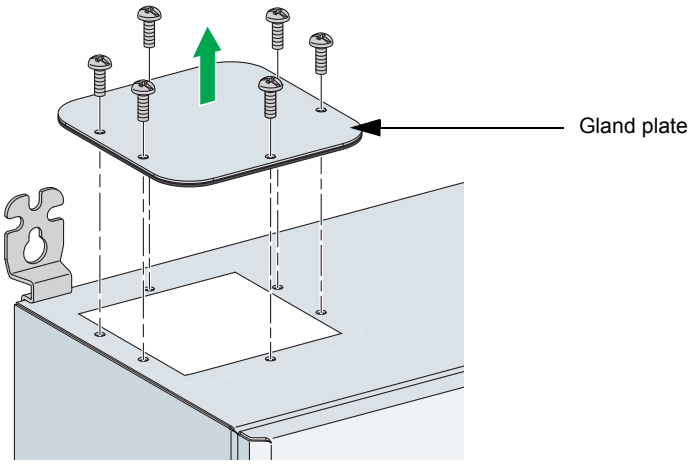
⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

Keep away from the enclosure or the cubicle when drilling to prevent shavings from falling into the equipment.

Failure to follow these instructions will result in death or serious injury.

1. Remove the gland plate.



2. Use drills or punches (depending on the diameters of the holes to be made) to allow the routing of:
   - three incoming power cables
   - the two wires of the current transformer (for models with automatic power factor correction)
   - the two wires for the alarm connection (for models with automatic power factor correction)
   - the grounding cable
   - the communication cable (depending on the version).
3. Run the cables through the gland plate using cable glands (not supplied) that are rated for the protection index of the equipment.

Cable terminations

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

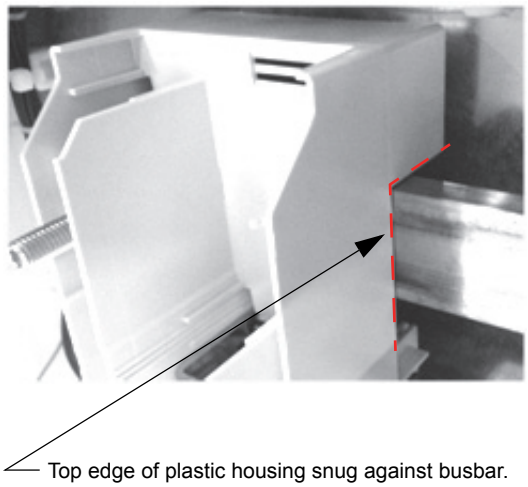
- Maintain adequate clearances when terminating cables. Do not leave more than 12 mm or 0.5 inch of bare copper extending beyond the lug.
- Ensure proper engagement between the bus bar, terminal, and cable when installing on a main lug type.

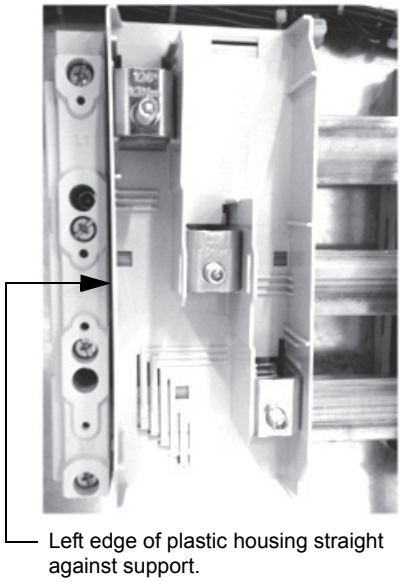
Failure to follow these instructions will result in death or serious injury.

When terminating cables:

- Use a proper insulation stripping tool to strip a length of insulation from the end of the cable sufficient to fit into the full length of the lug barrel. Be careful not to nick or ring the strands.
- Make the main lug connection between the cable and lug and bus bar all at the same time. Ensure that all parts are solidly connected before torquing.
- For main lug installation, loosen the lugs and insert each cable corresponding to the correct phase.
- With cables in place, torque each lug to the value given in “Torque values for connections” on page 61.

For main lug connection





Current transformer (CT)

NOTE: The CT is only necessary for automatic capacitor banks.

The CT provides a feedback signal required for the operation of the power factor controller. The CT is available as a separate reference in the VarSet catalog. The CT secondary rating must be 5 A, for example, with a ratio such as 2000/5, 1200/5, etc. Position the CT in the power system according to the diagrams in “Current transformer position” on page 31. Install it according to its installation instructions.

CT shorting bar

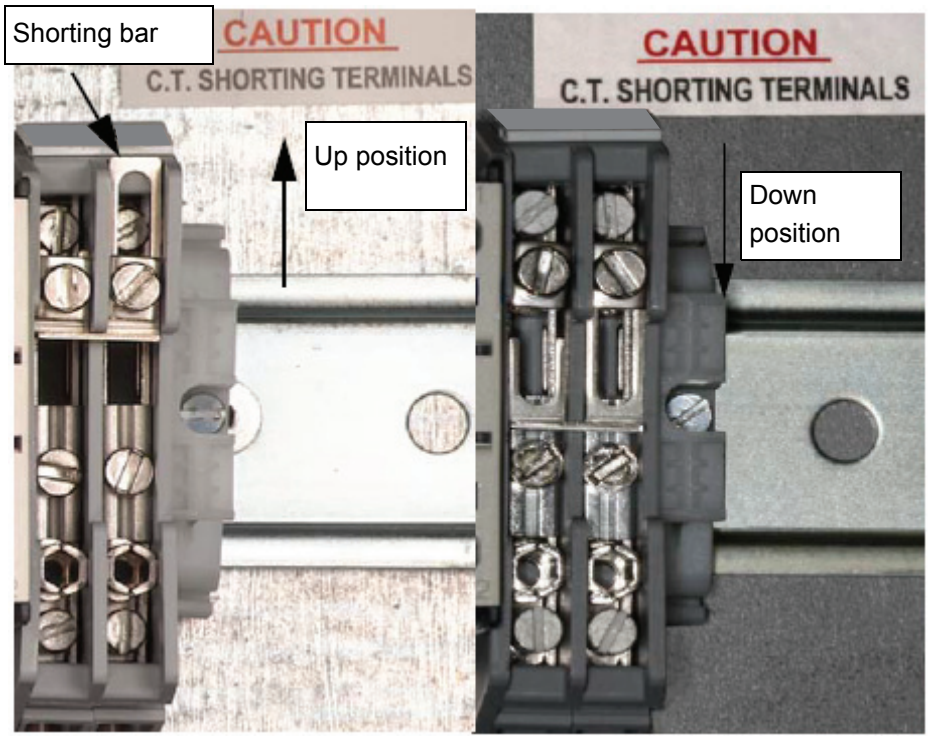
The CT terminal block in the capacitor unit has a CT shorting bar. Until the system is commissioned, the shorting bar should be pushed to the “up” position and tightened in place. This will short the CT secondary circuit.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

An open circuit CT secondary may develop lethal voltage. Short the CT terminals before and while working on CT circuits.

Failure to follow these instructions will result in serious injury or death.



NOTE: The CT shorting bar must be in the DOWN position for the Automatic capacitor bank to operate.

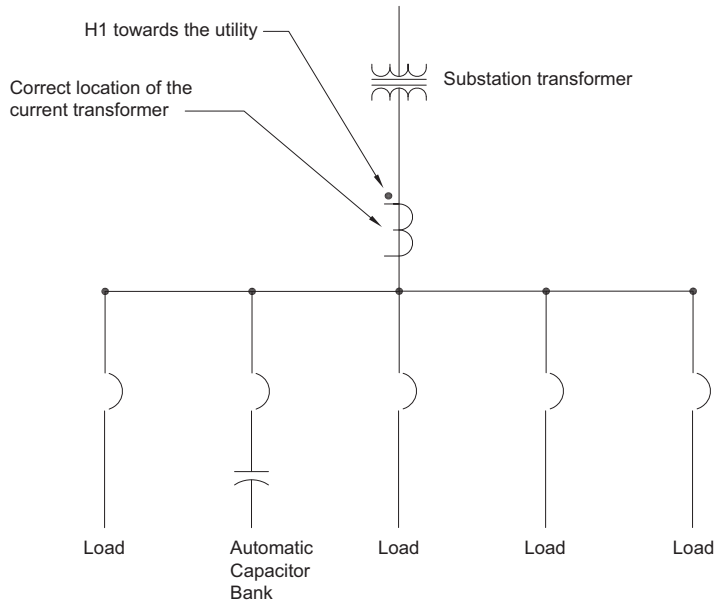
Current transformer position

Refer to the following single-line and three-line diagrams. The CT must be located:

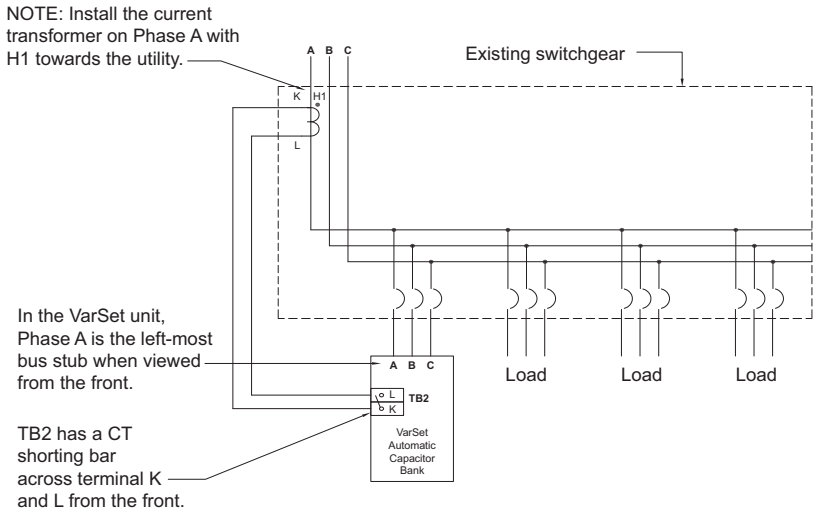
- On Phase A (which corresponds to the left-hand-side incoming cable terminal in the bank).
- Close to the substation transformer, on the line side of the main bus, ahead of all the loads and the capacitor bank.

Install CT wiring into terminal blocks K and L located within the equipment. Refer to the Three-line diagram below. Use properly rated wiring according to local codes and standards, environment, and length considerations.

Single-line diagram of a typical installation



Three-line diagram of a typical installation


NOTE: Install the current transformer on Phase A with H1 towards the utility.
A B C
Existing switchgear
K
H1
L
In the VarSet unit, Phase A is the left-most bus stub when viewed from the front.
A B C
L
K
TB2
VarSet Automatic Capacitor Bank
TB2 has a CT shorting bar across terminal K and L from the front.
Load
Load
Load

The CT should be installed with the correct polarity.

Alarm connection

For units with automatic power factor correction, there is a normally open contact that is closed under alarm conditions. This includes anytime the controller loses power as well as when any of the various alarms integrated into the controller are triggered. Normally, this includes Alarm 9: Overtemperature and Alarm 10: High THD (Total Harmonic Discharge). It is mandatory to connect to this alarm to externally monitor the status of the equipment.

Sizing the overcurrent protection device

A short circuit and overcurrent protection device must be provided upstream from the capacitor bank. Consult the appropriate section of the NEC or CEC for more information about overcurrent protection, cable ratings, and wire size determination.

Connection of the communication accessory

With the purchase of a unit capable of Modbus communication, the Modbus Communication Unit (MCU) comes installed along with a dedicated 24 V DC power supply. The cables necessary for external communication are not furnished with the equipment. It is recommended to use the cable TSXCSA100 (double shielded twisted pair) to make the RS-485 communication connection.

For instructions on the connection of this cable and programming the communications of the NRC12 controller, refer to the MCU guide 3653572 provided in the document pocket.

Chapter 6 Startup and commissioning

Instruments required for commissioning

- Voltmeter or multimeter
- Clamp-on ammeter
- Megohmmeter

Pre-energizing procedure

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

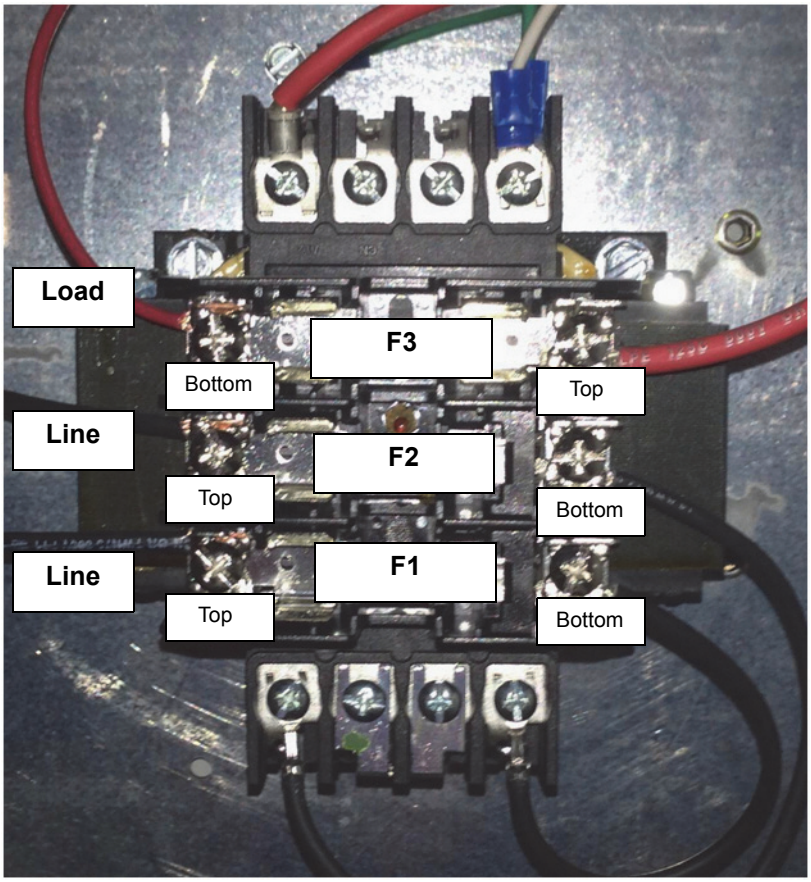
Failure to follow these instructions will result in death or serious injury.

Conduct a complete inspection before the capacitor bank section is energized.

Complete every step of the pre-energizing procedure listed before energizing the capacitor bank section.

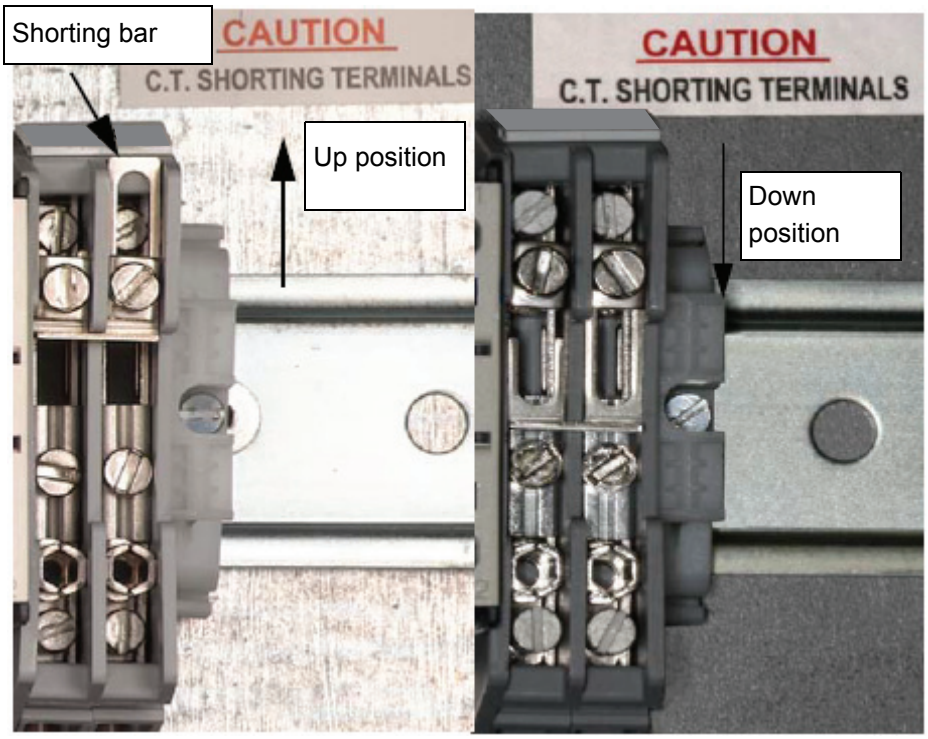
1. Ensure that the capacitor bank is de-energized. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed.

2. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, F3 (control fuses). There should be no voltage (0 V).

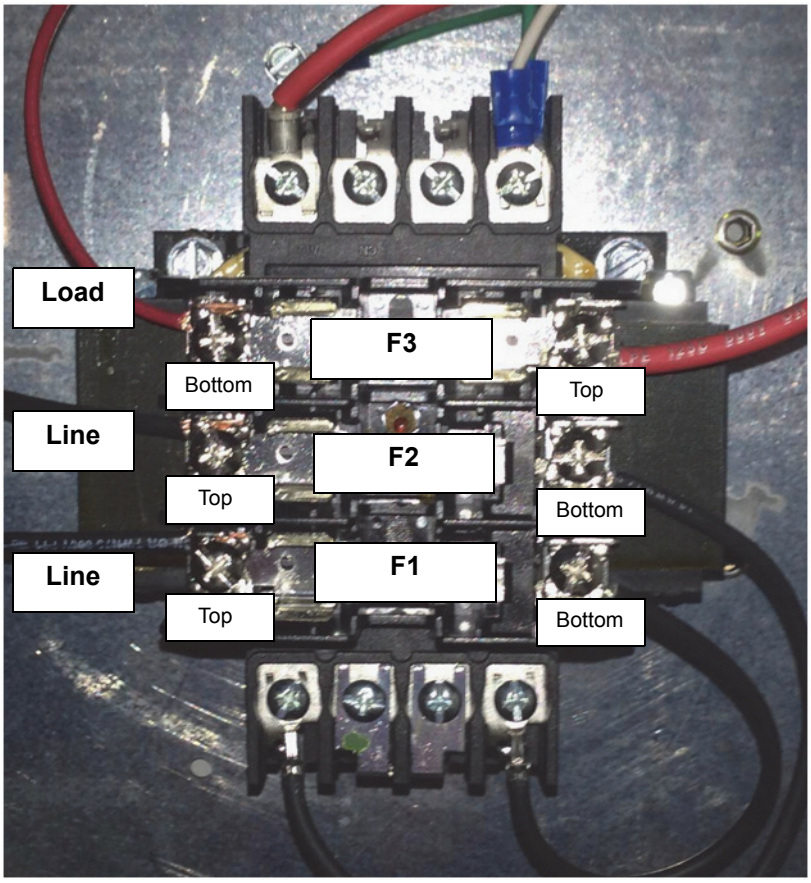


3. Repeat the test above at the top of F1, F2, F3. There should be no voltage (0 V).
4. Verify visually that the ground connection has been made at the ground lug. Verify electrical continuity between the ground lug and the accessible grounding studs on the door and fan(s).
5. Visual Inspection: Using a flashlight, inspect incoming cables, cable lugs, vertical bus, insulators, line and load side breaker cables, line and load side contactor cables, line and load side reactor cables (where applicable) and cables to the capacitors.
6. Ensure that all instruction material has been removed from the equipment (if desired) or placed securely in the document pocket provided.
7. Manually open and close all stage circuit breakers. Check for correct alignment and free operation. Leave all circuit breakers in the open (OFF) position.
8. Confirm that the CT has been installed on phase A of the main incoming bus or main breaker. Refer to “Single-line diagram of a typical installation” on page 31 for the correct CT location.

9. Inspect the CT shorting terminal block mounted in the middle of the control section. Make sure that the CT shorting bar is in the “Up” position. Confirm by taking current readings with a clamp-on meter. Only the customer supplied wires to the top of the CT shorting terminals should read current in the range of 0-5 A. If wires read in excess of 5A, verify cabling and connection points as well as CT size selection. If readings are still in excess of 5 A, call Schneider Electric for assistance.



10. Open circuit all control fuses F1, F2, and F3. Check these fuses for continuity. DO NOT REPLACE THE FUSES. Retain them outside the capacitor bank for the next series of steps. If a fuse is blown, investigate the cause and dispose of that fuse.



11. Inspect the rear of the controller for damage. Disconnect all wiring plugs from the rear of the controller.
12. Vacuum to remove any dust, scrap wire, or other debris.
13. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the 3-phase main bus bars or incoming lugs L-L and L-Ground. Record all measurements.
14. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the bottom cables of the stage breakers) L-L and L-GND. (Cables run from the bottom of the molded case circuit breaker to the top of respective phase of stage contactor). Record all measurements.
15. Using the megohmmeter (max 1000 V), perform an insulation resistance test on the cables on the bottom side of all 3-phase stage contactors (Line to Ground only). Record all measurements.

    NOTE: All resistance values should be 100 MΩ or greater.
16. If the resistance reads less than 100 MΩ while testing with the branch circuit devices in the open position, the system will need further investigation. Consult Schneider Electric for assistance.

17. Replace all covers; check for any pinched wires, and close doors. Make certain all enclosure parts are aligned properly and securely fastened. Keep stage breakers in the OFF/Open position. Retain fuses outside of the capacitor bank for the next set of steps.

    The capacitor bank is ready for startup. Refer to “Startup procedure” below.

Startup procedure

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

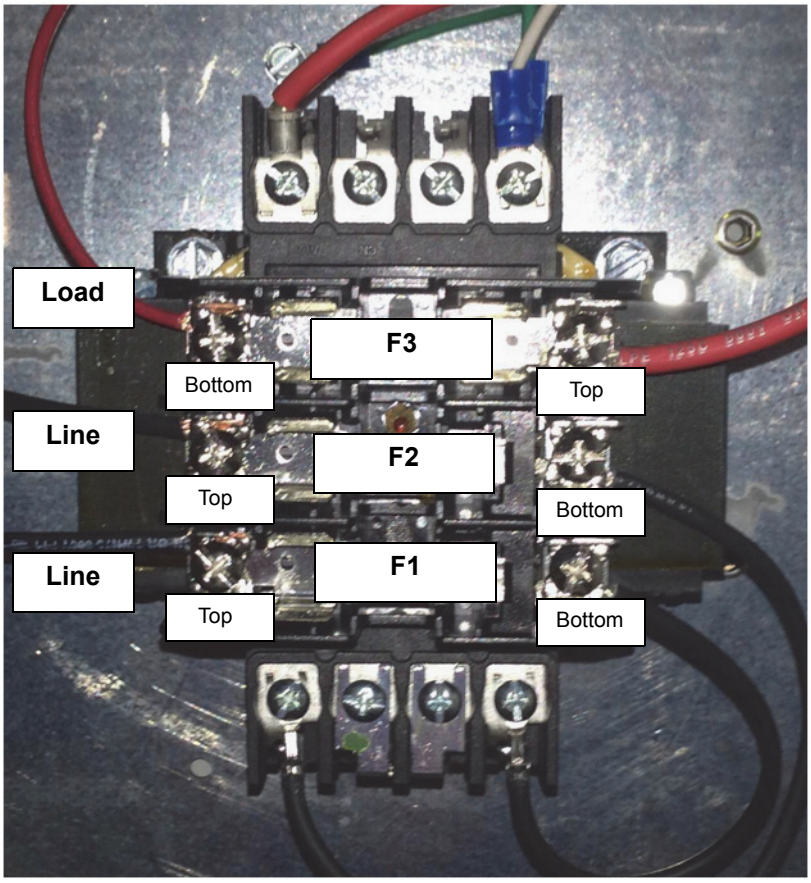
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

The following are steps to start up and commission the capacitor banks:

1. Record nameplate details on “Capacitor bank information” on page 65 for future reference.

2. Ensure that the capacitor bank is de-energized. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed.



3. Test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 control fuses. There should be no voltage (0 V).
4. Repeat the test above at the top of F1, F2, and F3. There should be no voltage (0 V).
5. Reconnect all controller plugs on the rear of the controller. Insert all control fuses, F1, F2, and F3.
6. Close up the capacitor bank unit. Close and engage the front door lock and door bolts.
7. Re-energize the capacitor bank unit by closing the main disconnect device. Program the VarLogic power factor controller following the step listed in “Power factor controller programming” on page 39. If installing a fixed capacitor bank, skip the programming and proceed to “Inspect and activate the capacitor bank” on page 47.

Power factor controller

Two types of power factor controllers are supplied by Schneider Electric. The widely used standard model is NR12, and advanced model is NRC12.

Varlogic NR12	Varlogic NRC12

Power factor controller programming

The display will be activated. Before proceeding, make sure you have available the following information:

- Current transformer ratio, for example: 3000/5.
- Nominal line to line voltage, for example: 600, 480.

	Note value:
CT Ratio:	
L-L Voltage:	
Target PF%:	
Minimum Step:	
Number of Steps:	
Stage Ratio:	
C/K Value:	

- Target power factor, for example: 0.98 lag.
- The minimum step size in VAR, i.e.,……12,500, 25,000, 50,000 VAR. Refer to “Controller programming information” on page 63.

  NOTE: Step sizes are typically referred to in kVAR. Multiply step size given in kVAR by 1000 to convert to VAR.
- Number of steps. This is usually equivalent to the number of contactors.
- Stage ratio. This information is provided in “Controller programming information” on page 63 in the form of 1,1,1,1... or 1,2,2,2,..., 1,1,2,2,2,...
- C/K value. This is a calculated value using the smallest stage size expressed as VAc, the CT ratio and the line to line voltage.

Example: for a 50 kVARc step (50,000 VARc), VL-L = 480V, CT=3000/5: C/K = 50,000 / {(3000/5) x 1.732 x 480} = 0.10……use 0.10.

The VarLogic power factor controller measures the current on Phase A (via the remote CT), and the voltage across Phases B and C (internally connected). It determines the reactive power required by the load and connects enough capacitor stages to meet this reactive power requirement until the power factor set-point is reached.

Manual setup of the NR12 controller

For the NR12 controller, follow the manual setup procedures in this section. Two of the controller menus need to be accessed. They are sections of “Parameter” and “Alarms”. Press “esc” or “enter” key to perform the following programming steps. Pressing the "esc" key during the process backs out of the current sub-menu and navigates back towards the main menu. For the NRC12 setup, refer to “NRC12 controller programming” on page 43.

1. Using the + or – arrows, move through the menu selection until reaching “PARAMET”.
2. Press “enter”.

   The unit displays “CODE 7”.
3. Press + and – together for 2 seconds and release

   The unit displays “CT”.
4. Press “enter”.

   The unit displays “%” or some other value.
5. Press + or – until reaching CT primary rating. For example, for a 3000/5 CT increment to 3000. (Changes are in increments of 25)
6. Press “enter”.

   The unit displays “CT”.
7. Press “-”.

   The unit displays “VOLTAGE”.
8. Press “enter”.

   The unit displays some number.
9. Use + or – increment to 120 (control volts).
10. Press “enter”.

    The unit displays “VOLTAGE”.
11. Press “-”.

    The unit displays “WIRING”.
12. Press “enter”.

    The unit displays “U L2–L3.”
13. Press “enter”.

    The unit displays “I1. AUTO”. If not, press + or – to increment.

14. Press “enter”.

    The unit displays “WIRING”.

15. Press“-“.

    The unit displays “COS PHI”.

16. Press “enter”.

    The unit displays “some number”. This is the target Power Factor (PF).

17. Use + or – to increment.

    For example, if 0.98 PF is desired, set the number to 0.98 lag (inductive). A small coil appears on the display indicating the inductive lag.

18. Press “enter”.

    The unit displays “COS PHI”.

19. Press “-”.

    The unit displays “MANUAL C/K”.

20. Press “enter”.

    The unit displays “some number”.

21. Use + or – to increment to C/K number.

22. Press “enter”.

    The unit displays “MANUAL C/K”.

23. Press “-”.

    The unit displays “AUTO C/K”.

24. Press “-”.

    The unit displays “DELAY”.

25. Press “enter”.

    The unit displays “some number”. Use + or – to increment to 50 seconds.

26. Press “enter”.

    The unit displays “DELAY”.

⚠ WARNING

RISK OF THE CAPACITOR LIFE REDUCTION

Once set to 50 seconds, do not modify the time delay setting.

Failure to follow these instructions can result in equipment damage.

27. Press “-”.

    The unit displays “PROGRAM”.

28. Press “enter”.

    The unit displays “something”. Use + or – to increment to “OPTIM”.

29. Press “enter”.

    The unit displays “PROGRAM”.

30. Press “-”.

    The unit displays “STEP.SEQ”.

31. Press “enter”.

    The unit displays “a series of numbers”. Use + or – to increment to stage ratio, for example 1.1.1.1 (Refer to “Controller programming information” on page 63.)

32. Press “enter”.

    The unit displays “STEPSEQ”.

33. Press “-”.

    The unit displays “N.STEPS”.

34. Press “enter”.

    The unit displays “some number between 1 and 12”. Increment to the number of stages.

35. Press “enter”.

    The unit displays “N.STEPS”.

36. Press “-”.

    The unit displays “VERIFY”.

37. Press “esc”.

    The unit displays “PARAMETER”.

38. Press “-”.

    The unit displays “ALARMS”.

39. Press “enter”.

    The unit displays “CODE 7”.

40. Press + and – keys simultaneously for three seconds and then release

    The unit displays “ALRMSET”.

    NOTE: There are 10 alarm conditions. Only A9 and A10 should be on.

41. Press “enter”.

    The unit displays “A1 ON”.

42. Press “–” to turn A1 off.

    The unit displays “A1 OFF”.

43. Press “enter”.

    The unit displays “A2 ON”.

44. Press “–” to turn A2 off.

    The unit displays “A2 OFF”.

45. Continue above steps to turn all alarms off except A9 and A10.

When it reaches A9, the unit displays “A9 ON”.

46. Press “enter”.

    The unit displays “A10 ON”.

47. Press “enter”.

    The unit displays “ALRMSET”.

48. Press “-”.

    The unit displays “THD.U.LIM”.

49. Press “enter”.

    The unit displays 7%. (Use +/- to set it to 7 if a different value is displayed).

50. Press “enter”.

51. Press “-”.

    The unit displays “TEMP.LIM”.

52. Press “enter”.

    The unit displays 50°C. (Use +/- to set to 50°C if a different value is displayed).

53. Press “enter”.

    The unit displays “TEMP.LIM”.

54. Press “esc”.

    The unit displays “ALARMS”.

55. Press “esc”.

    The unit displays the current status of the bank (I LOW or a power factor reading).

NRC12 controller programming

For the NRC12 controller, follow the programming procedures in this section. For the NR12 controller setup, refer to “Manual setup of the NR12 controller” on page 40.

1. Press “esc” to enter the list of sub-menus.
2. Using the “+” or “-” arrows, move through the menu selection until reaching “PARAMET”.
3. Press “enter”.

   The unit displays “CODE LOCK”.

4. Press “+” and “-” together for two seconds and release.

   The unit displays “Application”.

5. Press “enter” and use the “+” and “-” keys to change the parameter to “2 Quadrant”.
6. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to “0.5-50kV (VT)”.
7. Press “enter”.
8. Press “-”.

The unit displays “Transformers”.

9. Press “enter”.

   The unit displays “%” or some other value.

10. Press “+” or “-” until reaching the CT primary rating. For example, for a 3000/5 CT, increment to 3000. (Changes are in increments of 25).
11. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to the CT secondary rating (normally 5).
12. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to the VT rating (ratio of Network voltage to 120 V control voltage).
13. Press “enter”.
14. Press “-”.

    The unit displays “Input Voltage”.

15. Press “enter”.

    The unit displays the secondary voltage.

16. Use “+” or “-” to increment to 120 (control volts).
17. Press “enter”.

    The unit displays “Input Voltage”.

18. Press “-”.

    The unit displays “Wiring”.

19. Press “enter”.
20. Press “+” or “-” until reaching “L2-L3” (Voltage phase).
21. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to “L1” (CT phase).
22. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to “Auto” (CT polarity).
23. Press “enter”.

    The unit displays “WIRING”.

24. Press “-”.

    The unit displays “Target Cos”.

25. Press “enter”.

    The unit displays “some number”. This is the target Power Factor (PF).

26. Use “+” or “-” to increment. For example, if 0.98 PF is desired, set the number to 0.98 lag (inductive).
27. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to the same as in the previous step.
28. Press “enter”.

    The unit displays Cos 1 and Cos 2 (same).

29. Press “enter”.

    The unit displays “Resp Values”.

30. Press “enter” and use the “+” and “-” keys to change the parameter to “0.090”.
31. Press “F2”/“Next” and use the “+” and “-” keys to change the parameter to “0.090”.
32. Press “enter”.

    The unit displays an Inductive and Capacitive value of 0.090.

33. Press “-”.

    The unit displays “Auto Seek”.

    DO NOT PRESS “enter”.

34. Press “-”.

    The unit displays “Delays”.

35. Press “enter” and use the “+” and “-” keys to change the parameter to “50s”.
36. Press “enter”.

    The unit displays Reconnection value of “50s”.

> **⚠ WARNING**
>
> **RISK OF THE CAPACITOR LIFE REDUCTION**
>
> Once set to 50 seconds, do not modify the time delay setting.
>
> **Failure to follow these instructions can result in equipment damage.**

37. Press “-”.

    The unit displays “Step Program”.

38. Press “enter” and use the “+” and “-” keys to change the parameter to “Optimal”.
39. Press “enter”.

    The unit displays “Optimal”.

40. Press “-”.

    The unit displays “Step Setup”.

41. Press “enter” and use the “+” and “-” keys to change the parameter to the number of steps in your bank.
42. Press “F2”/“Next” and use the “+” and “-” keys to increment to the stage ratio, for example 1.1.1.1. (Refer to “Controller programming information” on page 63.)
43. Press “enter”.

    The unit displays the number of steps and the step sequence.

44. Press “-”.

    The unit displays “Fixed steps”.

45. Press “-”.

The unit displays “Verify”.

DO NOT PRESS “enter”.

46. Press “-”.

    The unit displays “Step Test”. This mode can be used to control the steps for testing and troubleshooting, but it is not required for programming.

47. Press “-”.

    The unit displays “Modbus Setup”. This section is to be used for Modbus Setup. Refer to Modbus controller instruction manual.

48. Press “-”.

    The unit displays “Language”.

49. Press “enter” and use the “+” and “-” keys to change the parameter to the desired language, “English degrees C” (typically).

50. Press “enter”.

    Programming of the parameters mode is now complete. Press “esc” to return to the Main Menu.

51. Press “-”.

    The unit displays “ALARMS”.

52. Press “enter”.

    The unit displays “Code Lock”.

53. Press “+” and “-” keys simultaneously for three seconds and then release.

    The unit displays “Alarm 1 Params”.

    Alarm 1 should be disabled. If not, press “enter” to select it. Press “-” to change it to “DISABLED” and press “enter” to confirm.

54. Press “-” to move to “Alarm 2 Params”.

55. Repeat and ensure that Alarms 1-8 are disabled.

56. Use the “+” or “-” keys to move to “Alarm 9 Params”.

57. Press “enter” and use the “+” or “-” keys to change the parameter to “ENABLED”.

58. Press “F2”/“Next” and use the “+” and “-” keys to increment to “50 degrees C”.

59. Press “F2”/“Next” and use the “+” and “-” keys to increment to “ON”.

60. Press “enter”.

    The unit displays “Limit of 50C, Disconnection ON”. Press the “F1” key to verify that “Mode” is “Enabled”.

61. Press “-” key to move to “Alarm 10 Params”.

62. Press “enter” and use the “+” or “-” keys to change the parameter to “ENABLED”.

63. Press “F2”/“Next” and use the “+” and “-” keys to increment to “7.0%”.

64. Press “F2”/“Next” and use the “+” and “-” keys to increment to “ON”.

The unit displays “Limit of 7.0%, Disconnection ON”. Press the “F1” key to verify that “Mode” is “Enabled”.

65. Press “-” and repeat step 52 to ensure that Alarms 11 and 12 are disabled.
66. Press “esc” to return to the Main Menu.

    Programming of the NRC12 controller is now complete.

Inspect and activate the capacitor bank

⚠ DANGER

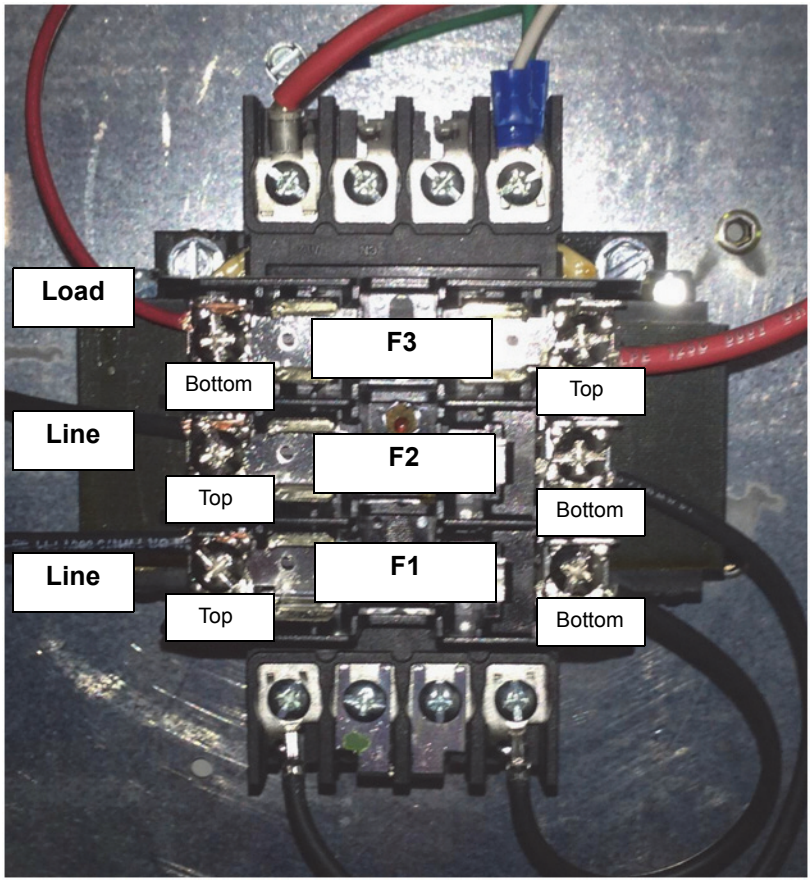
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

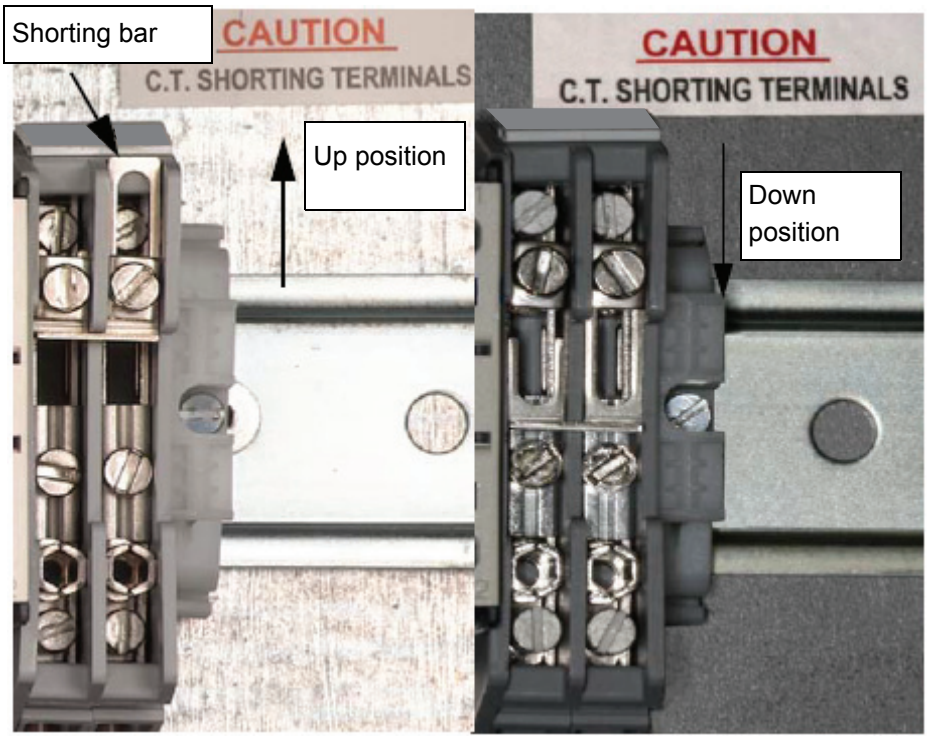
1. Open the main disconnect device to de-energize the capacitor bank. Wait a minimum of five minutes before preceding to step 2.

2. Open the front door of the capacitor bank and test for line voltage, L-L, L-GND at the bottom of F1, F2, and F3 control fuses. There should be no voltage (0 V).



3. Repeat the test above at the top of F1, F2, and F3. There should be no voltage (0 V).

4. Access the control section and move the CT shorting bar to the “down” position.



5. Close and engage the front door locks and door bolts.
6. Re-energize the capacitor bank.
7. Observe the controller. If it displays “I LOW….”, go to step 10. Stage 1 should be energized within 50-60 seconds, stage 2 should close 50 seconds after stage 1, stage 3 should close 50 seconds after stage 2, and so on until all stages are closed. The controller should highlight each number stage as it closes, i.e., white number in a darkened box visible along the bottom edge of the display.

   NOTE: The preceding operation depends on there being a sufficient load in the system.

Troubleshooting

1. If the controller indicates no stages are on, the controller is not displaying “I Low”, and there is a sufficient load, check the measured power factor on the display. If this power factor is greater than that programmed into the controller during setup (typically 0.95 lag), the unit will not switch stages on.
2. If the controller indicates no stages are on, check the controller display. If it displays “I LOW….”
   - Confirm that the CT shorting terminal is disengaged.
   - Confirm that there is load. (This depends on the kVAR level of the equipment. Typically 25 A minimum is required to activate the smallest step).
   - Use an AC ammeter to confirm that there is current through the wire into the top of terminal block X1 (0.25 – 5 Arms.)
   - Confirm that the CT is properly installed as per drawings.
3. If you confirm all items in the preceding step and have not discovered any issues, contact Schneider Electric.

4. If only some of the stages are turned on and the displayed power factor is close to that previously set during controller programming, it is necessary to manually control the stages. Refer to the procedures in “STEP.TST”.

STEP.TST

1. Use the “+” or “–” arrows to navigate through the menu selection until reaching “PARAMET”.
2. Press “enter”.

   The unit displays “CODE 7” or “Code Lock”.
3. Press “+” and “–” together for three seconds and release.

   The unit displays “CT” or “Transformers”.
4. Repeatedly press “-” until the unit displays “STEP.TST” or “STEP TEST”.
5. Press “enter”.

   The unit displays “ENT……OK”.
6. Press “enter”.

   The unit displays “1.OFF”.
7. Press and hold “enter” for three seconds.

   The unit displays “1.ON”. Stage 1 will turn on. The display will show a “1” in a small box on the bottom left.
8. Press and hold “enter” for three seconds.

   The unit displays “1.OFF”. Stage 1 will turn off. The display will no longer show the “1”.
9. Press “+”.

   The unit displays “2.OFF”.
10. Press and hold “enter” for three seconds.

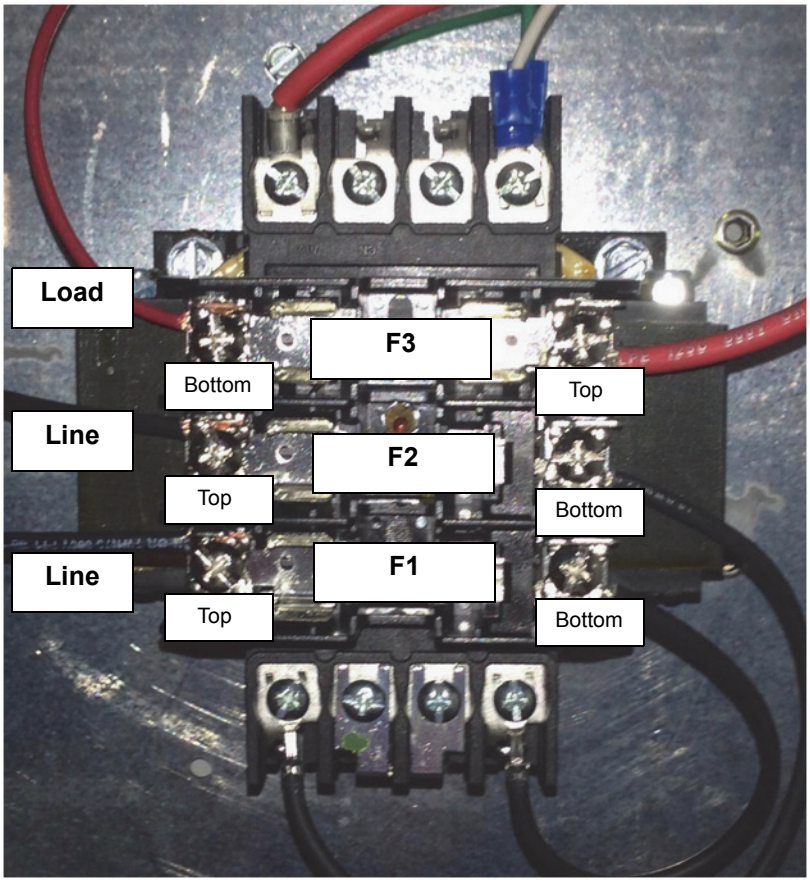
    The unit displays “2.ON”. Stage 2 will turn on. The display will show a “2” in a small box on the bottom left.
11. Press and hold “enter” for three seconds.

    The unit displays “2.OFF”. Stage 2 will turn off. The display will no longer show the “2”.
12. Repeat the preceding steps for all stages.

Complete the activation

1. Open the main disconnect device to de-energize the automatic capacitor bank.

2. To confirm line isolation, open the front door of the capacitor bank and test for line voltage, L-L, L-GND at the bottom of F1, F2, and F3 control fuses. There should be no voltage (0 V).



3. To confirm line isolation, repeat the test above at the top of F1, F2, and F3. There should be no voltage (0 V).
4. Close all stage breakers.
5. Close and engage front doors locks and bolts.
6. Re-energize the capacitor bank unit.
7. When sufficient load is present, the first stage should switch within 50 seconds. If you hear a very loud and sustained buzzing sound coming from the unit, immediately de-energize the unit. Contact Schneider Electric for assistance.
8. After five minutes, approach the unit and observe the controller to determine which stages are on. An “ON” stage appears as a white number in a darkened box visible along the bottom edge of the display.
   - If all stages turn on, go to Step 10.
   - If only some of the stages turn on, go to Step 11 with stage breakers closed.
   - If none of the stages turn on, go to Step 11 with stage breakers closed.
9. If all stages are “ON”, measure the stage currents. Measure each phase current twice in ten second intervals. For same size stages, all the phase current readings should be the same.

10. Use “STEP.TST” to manually control the stages for current measurements. Use procedures shown in “STEP.TST” on page 50 to turn on only the first stage first and measure and record the stage currents according to Step 10. Repeat for all stages.

    NOTE: Any unbalanced stage line current is a possible maintenance item requiring additional inspection.

11. While the stages are energized, measure the line to line RMS voltage, i.e. Va-b, Vb-c, and Vc-a and record the results on “Voltage and stage current record” on page 67.

Chapter 7 Preventive maintenance (PM)

The interval between maintenance checks can vary depending upon the amount of usage and environmental conditions of each installation. The following preventative maintenance procedure should be carried out by qualified personnel three months after commissioning of the new unit, and at least once every 6-12 months thereafter.

First scheduled PM (three months after commissioning)

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

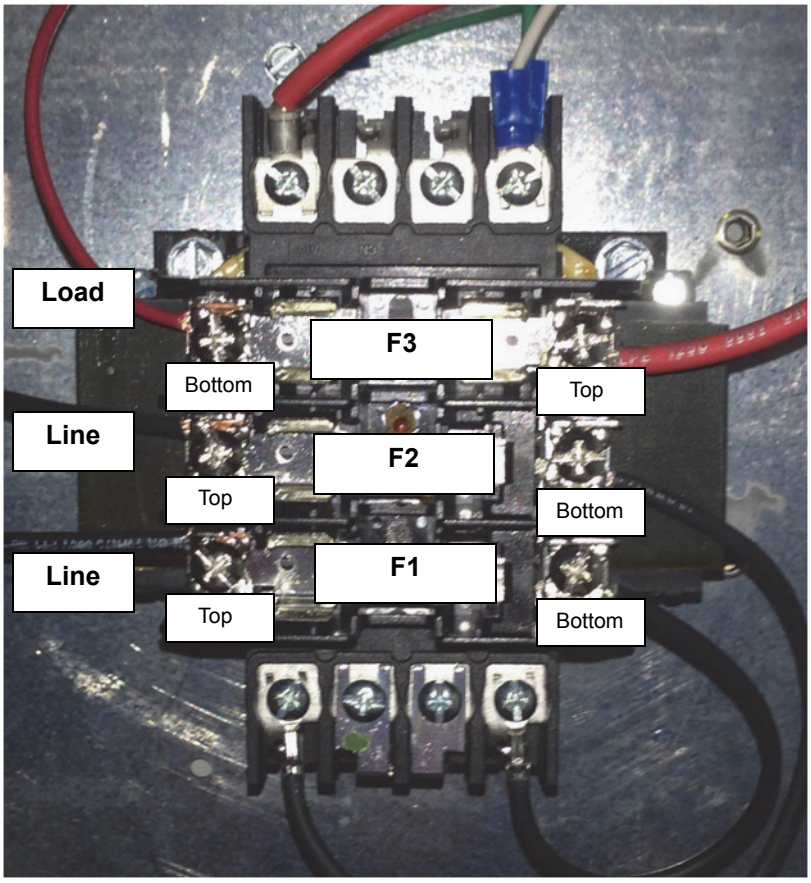
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

1. Check the controller display to confirm it is active and there are no alarm conditions. (Refer to the Varlogic user manual for alarm details.)
   - Alarm A9: Indicates the internal temperature has exceeded the thermal limit of 122°F (50°C).
   - Alarm A10: Indicates the maximum THD (7%) has been exceeded.
2. Check to confirm that the cubicle ventilation fans are active. (When the unit is in operation for at least two hours with full load, the fans are normally on). If the fans are not on, you may verify by temporarily adjusting the thermostat 1 inside. To do so, power down the upstream main breaker, wait 5 minutes, then open the equipment and adjust ST1 to below room temperature. Re-close the door and secure it before re-engaging the main circuit breaker. Once the functionality has been verified, repeat the procedure to reset the thermostat dial back to 95°F (35°C).
3. Check to confirm that all ventilation openings are clear.
4. With the unit in full operation (all stages on), listen and identify the source of any loud noise, i.e. >50 dB. Those identified noise sources are possible maintenance items which require further investigation. If nothing is found and the noise persists, contact Schneider Electric.
5. Open the disconnect to de-energize the capacitor bank. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out,

tag-out procedure is followed and wait five minutes before opening the door to the capacitor bank.

6. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no voltage (0 V).



7. Manually trip all stage breakers and then reset to ON.

   NOTE: Signs of over-temperature on components are changes in appearance of their surface, such as duller, shinier, cracked, brittle, or burnt. Any change of color or appearance that differs from other identical components should be investigated.

8. Close and engage the front doors locks and door bolts.

   If the section internal temperature exceeds 122°F (50°C), the controller and/or the thermostat will initiate a thermal trip function shutting down the entire unit. If there is an incoming circuit breaker, it will need to be reset in this instance.

Regularly scheduled PM (every 6-12 months)

⚠ DANGER

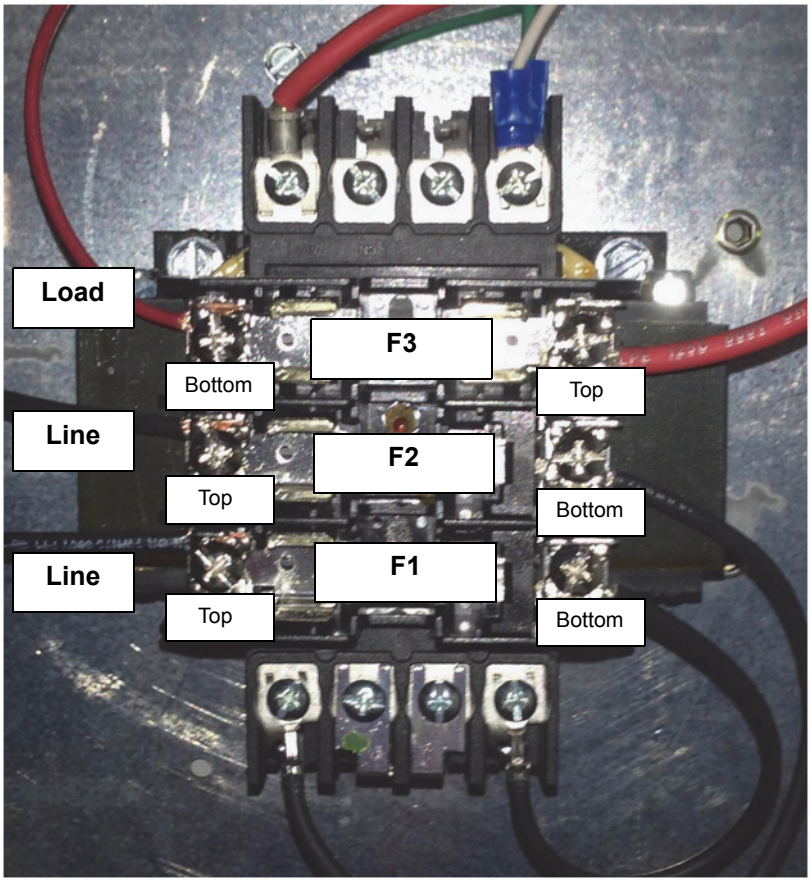
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

1. Repeat steps outlined in “First scheduled PM (three months after commissioning)” on page 53.
2. Use the procedure in “STEP.TST” on page 50 to manually turn the first stage on. Measure and record line to line voltage on “Voltage and stage current record” on page 67.
3. Use the procedure in “STEP.TST” on page 50 to manually turn one stage on at a time. With the stage energized, measure the stage’s 3-phase line currents and record the results on “Voltage and stage current record” on page 67. Manually turn the stage off before turning on the next stage. Repeat the measurement for each stage as above.
4. Open the main disconnect device to de-energize the capacitor bank and wait five minutes.

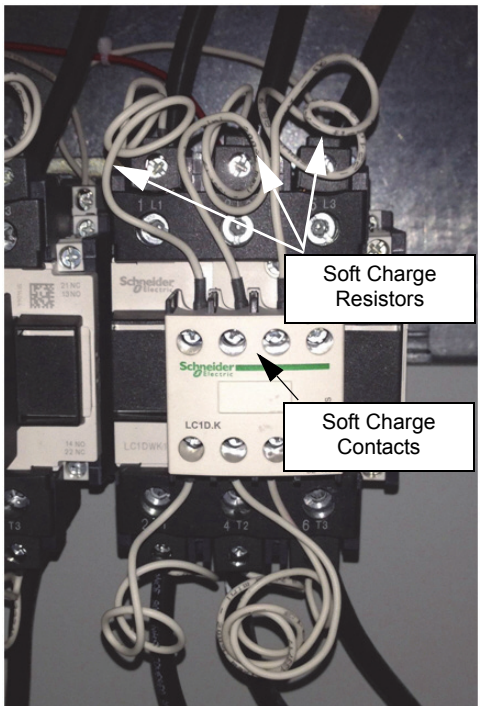
5. Open the front door of the capacitor bank and test for line AC voltage, LL, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no AC voltage (0 V).



6. Repeat the test above at the top of F1, F2, and F3. There should be no AC voltage (0 V).
7. Using a DC voltage meter or multimeter set to DCV (1000 VDC capable), test each capacitor stage for residual DC voltage:
   - At the bottom of each stage contactor (load side), measure line to line and line to ground voltages (A-B, A-C, B-C, A-GND, B-GND, C-GND).
   - If any reading is higher than one volt, the capacitor is not fully discharged and should be isolated for further investigation.
8. Inspect the capacitor bank for any signs of overheating. Discoloration and flaking of insulation or metal parts are indications of overheating.

   NOTE: If overheating occurs, be sure that all conditions that caused the overheating have been corrected. Loose or contaminated connections can cause overheating.
9. Check all field-installed bus bar connections. Torque values are listed in “Torque values for connections” on page 61.
10. Check all terminal lugs for any pitting, corrosion, or discoloration resulting from high temperatures or subjection to high fault conditions. If any damage has occurred, the lugs must be replaced. Call Schneider Electric for assistance.

11. Verify visually that the ground connection is still solid. Perform an electrical continuity check between the grounding lug and grounding studs on the door and fan.
12. Use a screwdriver to ensure all contactor armatures have full travel and do not bind at any time.
13. Check to ensure that all contactor charge resistors (VLVAW only) are intact. There are six soft charge resistors mounted between each of the main phase contacts and the corresponding phase of each auxiliary contact block. Visually inspect all capacitors for cracked or split tubes. A flashlight and mirror may be required. As an alternative, run your fingers along the surface of the capacitor tubes to feel any cracks or splits.



14. Vacuum to remove any dust or other debris.
15. Check the capacitor bank interior carefully for moisture, condensation build-up, or signs of any previous wetness. Moisture can cause insulation failures and rapid oxidation of current-carrying parts. Inspect all conduit entrances and cracks between the enclosure panels for dripping leaks. Condensation in conduits may be a source of moisture and must not be allowed to drip onto live parts or insulating material.
16. Take the necessary steps to eliminate the moisture and seal off all leaks.
17. Check for any pinched wires and close doors. Make certain all enclosure parts are aligned properly and securely fastened.

Replacement of components

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E or CSA Z462.
- This equipment must be installed and serviced only by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- After removing power, wait for 5 minutes to allow the capacitors to discharge prior to opening the doors or removing covers.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors, and covers before turning on power to this equipment.
- Carefully inspect the interior for tools left behind before closing and sealing the door.

Failure to follow these instructions will result in death or serious injury.

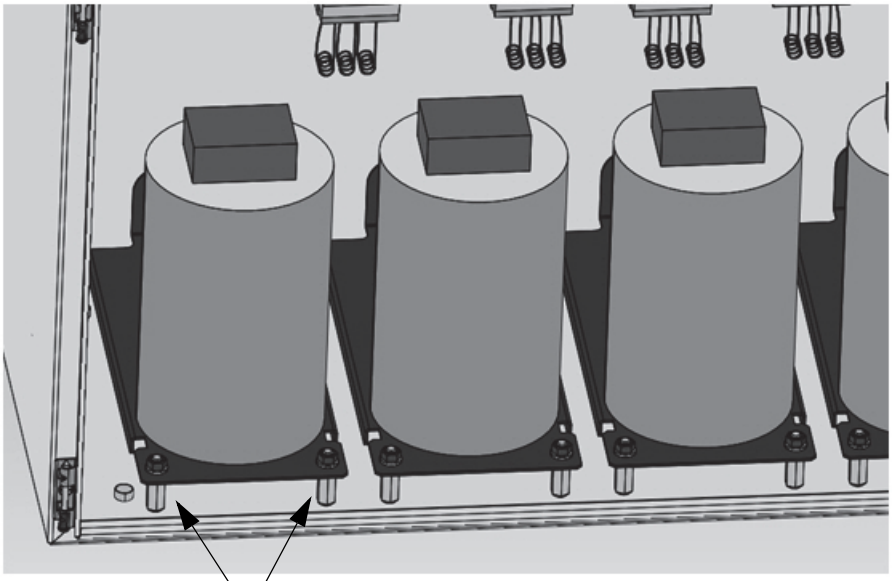
During maintenance, if any capacitor step is found to be losing capacitance, the capacitor must be replaced. During normal operation conditions, the following components must also be replaced at these intervals:

	Years of continuous use (Ambient 35°C [95°F] or not measured)	**Years of continuous use (Ambient 25°C [77°F])**
Capacitor	7	10
Contactor	7	10

To replace the capacitor:

1. Open the disconnect to de-energize the capacitor bank. Ensure that the external upstream main breaker feeding the capacitor bank is open. Make sure the lock-out, tag-out procedure is followed and wait five minutes before opening the door to the capacitor bank.
2. Open the front door of the capacitor bank and test for line voltage, L-L, L-Ground at the bottom of F1, F2, and F3 (control fuses). There should be no voltage (0 V).
3. Manually trip all stage breakers
4. Remove wires from all three phases of the capacitor.

5. Remove two M8 nuts and washers from the capacitor plates.



6. Carefully lift the capacitor plate out from the bank. Avoid scratching or damaging other components when removing. The maximum weight of two capacitors and the plate is 25 lbs (11.34 kg).
7. Remove the capacitor by undoing the single nut and washer on the bottom of the capacitor plate. Remove and replace, torquing according to specifications in the instruction bulletin provided with the new capacitor.
8. Replace the device plate and M8 nuts and washers.
9. Re-cable and torque according to specifications in the capacitor instruction bulletin.

Chapter 8 Torque values for connections

Incoming connection lug torque values		
Lugs	**lb-in**	**N•m**
0-75 kVAR	71-89	8-10
100-200 kVAR (480 V)	106-133	12-15
100-250 kVAR (600 V)		
225-300 kVAR (480 V)	266	30
Incoming Circuit Breaker		
PowerPact H (AL150HD)	50 for #14-#10 awg wire and 120 for #8-3/0	5.5 for #14-#10 awg wire and 14 for #8-3/0
PowerPact J (AL175JD)	225	25
PowerPact J (AL250JD)		
PowerPact L (AL600LS52K3)	442	50

Contactor connection torque values		
Contactor Type	**lb-in**	**N•m**
LC1DWK	79	9
LC1DMK	22	2.5
LC1D80	79	9
LC1D32	22	2.5
Control Connection - all types	10.5	1.1

Capacitor connection torque values		
Capacitor Type	**lb-in**	**N•m**
Stud-Type (50 kVAR 480 V)	107	12
Clamp-tite (25 kVAR or below)	22	2.5

Reactor connection torque values		
Reactor Type	**lb-in**	**N•m**
25 kVAR or 50 kVAR Reactor (M6 bolt)	89	10

Control voltage transformer connection torque values		
Connection type	**lb-in**	**N•m**
Transformer tap and grounding screw (6-32)	9	1.0
Fuse connector (8-32)	16	1.8

Other torque values		
	lb-in	**N•m**
Control power connections	10.5	1.1
Ground connection	89	10

Chapter 9 Lug and wire size information

Incoming wiring		
Lugs	**Wire Size Accepted**	**Torque**
0-75 kVAR	10 awg - 2/0 awg	71-89 lb-in (8-10 N•m)
100 kVAR	(1) 2 awg - 250 MCM	106-133 lb-in (12-15 N•m)
125-200 kVAR (480 V)	(2) 2 awg - 250 MCM	
125-250 kVAR (600 V)	(2) 2 awg - 250 MCM	
225-300 kVAR (480 V)	(2) 250 MCM - 600 MCM	266 lb-in (30 N•m)
Main Circuit Breaker		
PowerPact H (AL150HD)	14 awg - 3/0 awg	50 lb-in (5.5 N•m) for #14-1#10 awg wire and 120 lb-in (14 N•m) for #8-3/0
PowerPact J (AL175JD)	4 awg - 4/0 awg	225 lb-in (25 N•m)
PowerPact J (AL250JD)	3/0 awg - 350 MCM	225 lb-in (25 N•m)
PowerPact L (AL600LS52K3)	(2) 2/0 - 500 MCM	442 lb-in (50 N•m)
Grounding Connection		
0-100 kVAR	14 awg - 4 awg	
>125 kVAR	6 awg to 1/0 awg	

NOTE: Wire must be sized to carry 135% of nominal current. Increase size appropriately to comply with all local standards and environmental conditions as well. Use 90°C (194°F) Copper wire.

Controller programming information				
Type	**kVAR**	**Minimum Step**	**Number of Steps**	**Stage Ratio**
VLVAW2N or VLVAW3N	25	12.5	2	1.1.1.1
	50	12.5	3	1.1.2.2
	75	12.5	3	1.2.3.3
	100	25.0	3	1.1.2.2
	125	25.0	3	1.2.2.2
	150	25.0	4	1.1.2.2
	175	25.0	4	1.2.2.2
	200	50.0	4	1.1.1.1
	225	25.0	5	1.2.2.2
	250	50.0	5	1.1.1.1
	275	25.0	6	1.2.2.2
	300	50.0	6	1.1.1.1
VLVFF4P or VLVAF4P (with Detuned Reactor)	75	25	2	1.2.2.2
	100	25.0	3	1.1.2.2
	125	25	3	1.2.2.2
	150	25.0	4	1.1.2.2
	175	25	4	1.2.2.2
	200	50.0	4	1.1.1.1

Chapter 10 Maintenance records

Equipment information

Record the equipment nameplate information here.

Capacitor bank information	
Factory Number	
Equipment Type	
Voltage Rating	
Maximum kVAR Installed	
Current Rating (Amps)	
I_{eff}	
Smallest Step Size (kVAR)	

Installation and maintenance log

Record installation and maintenance activities performed on the unit here.

Date	Task description	Name/initials

Main bus insulation resistance record

Record dielectric resistance measurements for the main bus insulation here.

Date	Main bus phase to ground		
	a-ground MΩ	b-ground MΩ	c-ground MΩ

Contactor insulation record

Record dielectric resistance measurements for the contactor insulation here.

Date	Contactor number	Contactor phase to ground		
		a-ground MΩ	b-ground MΩ	c-ground MΩ

Voltage and stage current record

Record voltage and stage current here.

Voltage and current measurement							
Date	**Stage number**	**Va-b**	**Va-c**	**Vb-c**	**Ia**	**Ib**	**Ic**

Chapter 11 Dimension and weight information

The typical VarSet weight for the largest power rating per enclosure is listed in the following table.

Section dimension and weight										
Frame size	**Height**		**Width**		**Depth**		**D1 (Maximum distance the door will open away from the back wall)**		**Weight (max)**	
	Inch	**mm**	**Inch**	**mm**	**Inch**	**mm**	**Inch**	**mm**	**lb**	**kg**
VLVAW2N	33.5[1]	850[1]	31.5	800	15.7	400	47.2	1200	175	80
VLVAW3N	47.2[1]	1200[1]	39.4	1000	15.7	400	55.1	1400	330	150
VLVAF4P	51.2	1300	51.2	1300	15.7	400	47.2	1200	585	265

[1]Does not include plinth, optional on VLVAW2N and VLVAW3N, which adds 100 mm (3.9 in) to height.

NOTE: Weight information is approximate and subject to change without notice.

Chapter 12 Change the language in the controller

NOTE: These procedures apply to the NR12 only.

The controller language has been set to English at the factory. When the controller is powered up, the display will show English as the factory default language. To change the language displayed, follow these steps:

1. Push the “esc” button once to back out of the “display” mode.

   The controller displays “MEASURE”.

2. Push the “+” button three times to move up through the menu to “BANKPRE”.
3. Push the “enter” button.

   The controller displays “CODE 7".

4. Push “+” and “-” buttons simultaneously for three seconds.

   The controller displays “LANGUAG”.

5. Push the “enter” button.

   The controller displays “ENGLISH”.

6. Push the “-” button once to step to “FRANCE” or twice for “ESPANOL”. Press “enter” to select the language.

   The controller displays “TENSION”.

7. Push the “esc” button once to return to the main menu.
8. Step through the main menu by pushing the “-” button 4 times until reaching “PARAMET”.
9. Proceed with “Manual setup of the NR12 controller” on page 40.

Schneider Electric

35, rue Joseph Monier
CS 30323
F - 92506 Rueil Malmaison Cedex
www.schneider-electric.com

© 2014 Schneider Electric. All Rights Reserved.

EAV8833200 07/2014

VarSet and Varlogic are either a trademarks or registered trademarks of Schneider Electric in France, the USA and other countries. Other trademarks used are the property of their respective owners.